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# Clay Machinery Presents Problems

## Aside From the Methods Involved in Making the Molds the Principal Factor Is To Supply Metal of Varying Analyses To Suit the Different Classes of Castings

IN VIEW of modern conditions it is hard to believe that the ancient land of Egypt once was the abode of a dominant and mighty people who held another race in subjection for over 400 years. The arts and sciences were cultivated to a high state of perfection and although the standards of excellence were not those of modern days, the Egyptians have left behind them monuments of engineering skill that never have been duplicated. These have withstood the wear and tear of the ages and the swirling dust and sand storms of the desert for 4000 years. Autocratic, imperious, unbending, a long line of Pharaohs succeeded each other and sat upon the imperial throne of Egypt. Each in turn was gathered to his fathers, his body embalmed and laid away in one of those mighty sepulchers that still stand silently in the valley of the Nile and which in all probability will stand in silent grandeur until time is no more.

Among other interesting items touched upon in the Book of Exodus we learn that brick making was practiced extensively in those days. The Israelites performed all the manual labor, while the haughty Egyptians acted as overseers and task masters. The clay used was of a sandy nature and because of this and also the fact that the bricks simply were dried in the sun, it was necessary to mix chopped straw in the clay batch to give the bricks strength. Each gang of workmen had to produce a given quota of bricks per day. A second gang was employed to gather the straw, chop it and furnish the brick makers a constant supply. Under these conditions apparently the workmen were contented. With a view of oppressing them still further and make their yoke more galling, Pharaoh issued an edict that in future each gang should furnish its own straw and at the same time keep up its daily quota of finished bricks.

Carrying out this ordinance passed the bounds of human endurance and resistance on the part of the Israelites

FIG. 1—THE COKE IS DUMPED INTO A SET OF STEEL HOPPERS IN A CONCRETE PIT FROM WHICH IT IS AFTERWARD TAKEN BY A SKIP BUCKET INTO THE COKE STORAGE BUILDING SHOWN AT THE EXTREME LEFT

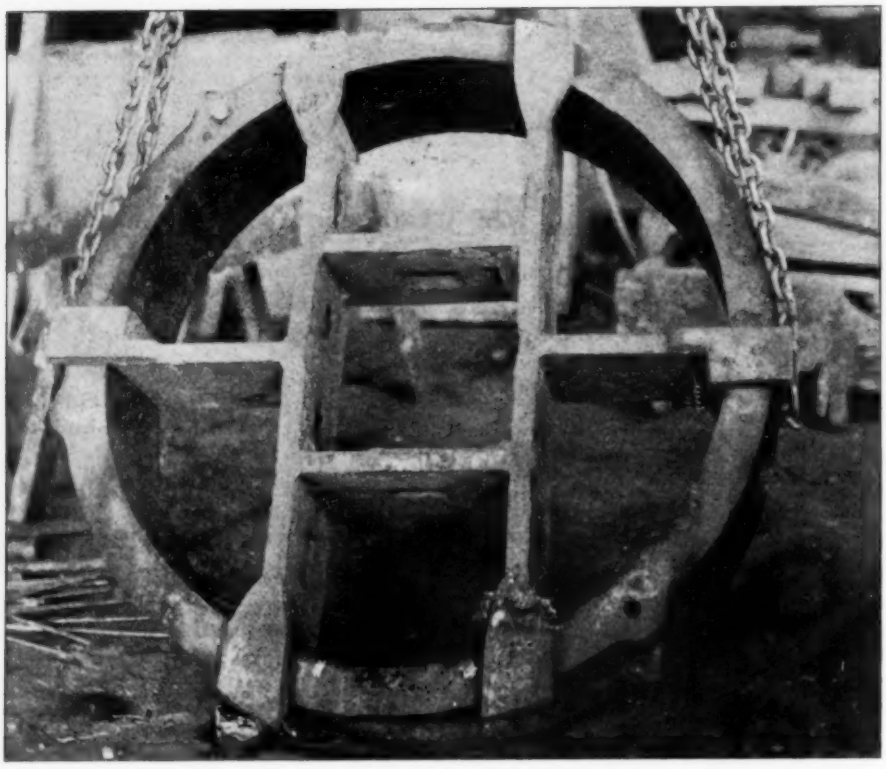

FIG. 2—THE SPIDERS ARE CAST SEPARATELY FROM THE RING AND ARE HELD IN PLACE BY BOLTS OR BY CLAMPS ATTACHED TO THE TOP FLANGE

was the beginning of the end of Egypt as a nation. Through the instrumentality of Moses the land practically was ruined. It was ravished and raided by a succession of plagues. Rivers that ran blood, frogs, flies and lice, a murrain among the cattle, death to the firstborn in every household, thunder, lightning and hail that destroyed the standing grain and a flight of locusts that stripped every green and living thing spared by the storm. All this culminated in the passage of the Red Sea in which Pharaoh, his horses and chariots were overwhelmed by the rushing waters and destroyed.

Bricks are made today in Egypt, but they are made by hand and sun dried as in the days of the Pharaohs. They also are made to a limited extent on the banks of the Tigris and the Euphrates, that portion of the earth's surface popularly credited with the distinction of being the original Garden of Eden and also as being the site of the famous tower of Babel. That ambitious structure was built of sun dried brick and the theory that it collapsed from lack of inherent strength is just as plausible as the generally accepted story that work was abandoned on account of a lack of uniformity of language among the workmen.

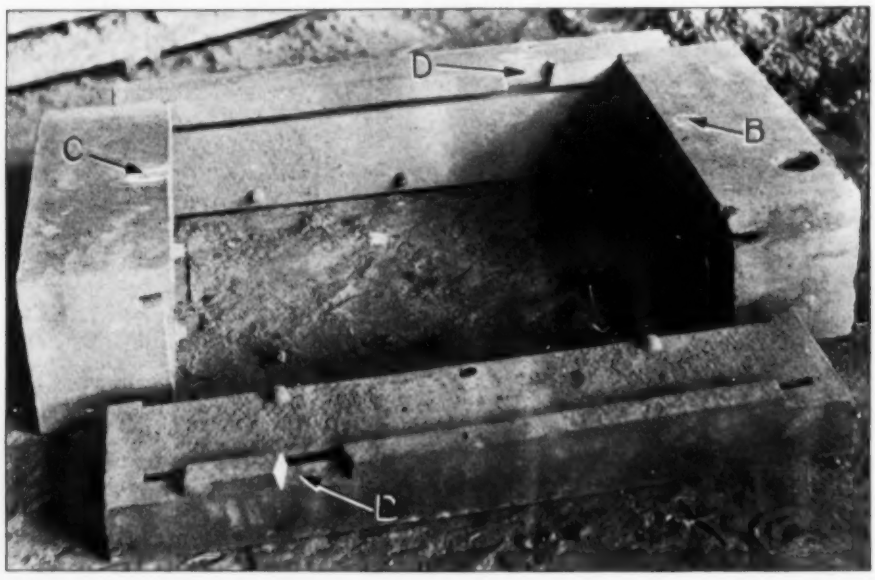


FIG. 3—A SET OF CORES FOR MAKING A RECTANGULAR STEEL FLASK—THE INTERIOR IS RAMMED IN GREEN SAND

The first great innovation in the brick making trade took place when it was discovered that the bricks could be dried or burned with fire. When treated in this manner, they were rendered practically indestructible and capable of supporting enormous weights. It is only natural that this process should have been invented and practiced in European countries where fuel was plentiful.

The second great improvement in the manner of producing bricks is of comparatively recent origin and consists of a power driven apparatus which turns out 100,000 bricks a day. It is estimated that approximately 8000 brick plants in the United States and Canada are equipped wholly or in part with modern clay working machinery while the remaining 4000 plants depend almost altogether on hand labor. The immense volume of castings required to equip these various clay working plants and afterward to keep them in repair is responsible for the erection of several foundries which specialize in that particular line.

### *Castings for Clay Working Plants*

One of the largest foundries in the country devoted to the manufacture of castings entering into the machinery and appliances employed in clay working plants is that of the Hadfield-Penfield Steel Co., Bucyrus, O. This plant which formerly was known as the American Clay Machinery Co., operated a second plant at Willoughby, O. Recently the company has become affiliated with the famous English steel firm of Hadfield's, Ltd., acquiring the American right to use the alloy steels developed in England. During the war the firm made a diversified line of castings in addition to its regular product. These included machine tools and gasoline locomotives. The latter are built in three sizes and have been retained as a regular part of the company's product. These locomotives are used for a variety of purposes, but a considerable number are employed in and around clay pits and for that reason may properly be classed as pieces of clay working machinery.

The foundry building is located on a plot of land comprising 22 acres owned by the company and situated about a mile distant from the remainder of the plant comprising the machine shop, erecting shop, boiler shop, offices, etc. The main bay of the foundry is 55 x 780 feet. The two side bays are not continuous, that is they are divided by partitions at various points; but they

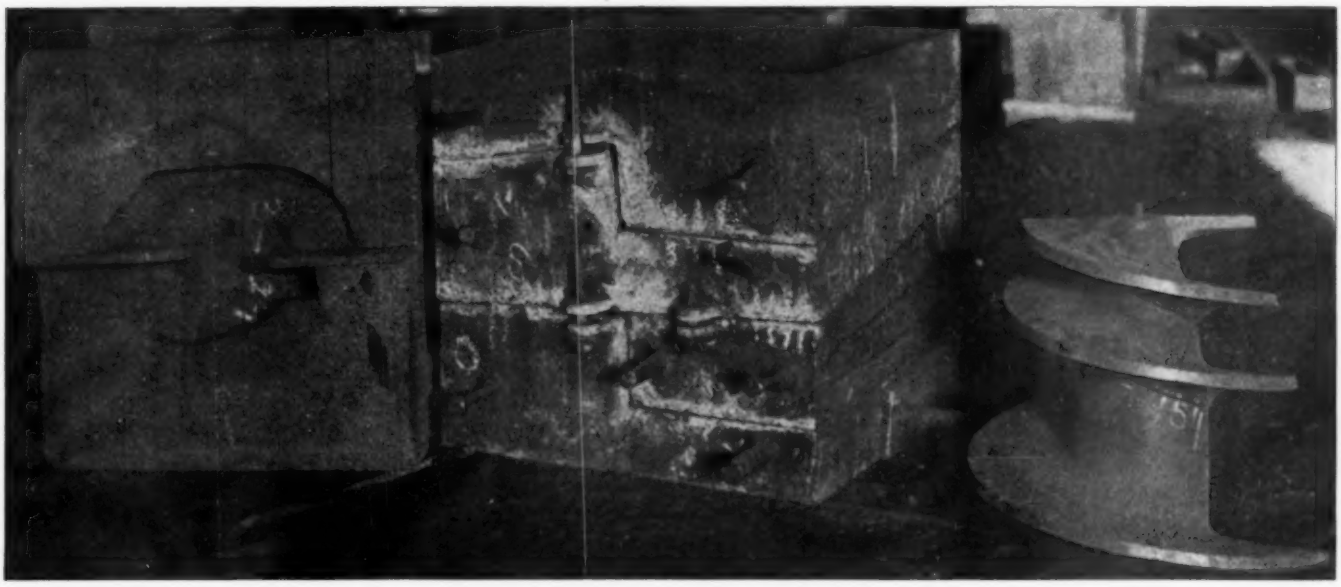

FIG. 4—FOLLOW BOARD, SPECIAL CUT FLASK AND PATTERN FOR MOLDING THE AUGUR WHICH PUSHES THE CLAY THROUGH THE DIE IN THE END OF THE PUG MILL

extend from one end of the building to the other. One of these is 40 feet wide and the other is 30 feet.

The 40-foot bay, taking them in order, houses the power plant, an extensive side floor devoted to molding all the smaller castings, a wash and locker room, the foundry superintendent's office and a well equipped laboratory. The bay on the opposite side of the building is occupied by a pattern and flask repair shop, casting cleaning room, annealing ovens, cupolas, converters, the core making department and finally at the end of the building a space set apart for preparing the steel foundry facing sand.

The foundry is designed and equipped for the production of both iron and steel castings. The iron is melted in three cupolas made by the Whiting Corp., Harvey, Ill., and the steel is made in two 2-ton bessemer converters supplied by the same company. Two of the cupolas are lined to 38 inches inside diameter and the third is lined to 36 inches. The smaller cupola is employed almost exclusively in melting iron for the converters.

Air for the cupolas formerly was supplied by two fans. These have been replaced by a turbine blower made by the General Electric Co., Schenectady, N. Y., and driven by a 50-horsepower motor made by the same company. Since the two converters are never used at the same time, one No. 5 blower made by the P. H. & F. M. Roots Co., Connersville, Ind., and driven by a 75-horsepower General Electric motor supplies all the air. The blower is attached to a main pipe having two branches, one leading to each vessel. Each branch is provided with a shut off gate so that the air may be diverted to either one of the converter vessels.

The general arrangement of the yard in the vicinity of the cupola house is shown in Fig. 1. The illustration is rather deceiving inasmuch as it conveys the impression that the inclined railway starting about the center of the extreme right passes close to the end of the cupola house. As a matter of fact there is a roadway between the track and the end of the building approximately 20 feet wide. The inclined railway terminates over an open hopper or chute which discharges into the concrete basin shown at *A*, Fig. 1. The coke cars are run up this incline and the contents dumped into a series of steel hoppers suspended inside the concrete basin. Each hopper is provided with a gate which may be raised or lowered allowing the contents to flow into a small car attached to a cable which carries the coke up a second incline and discharges it into the coke storage building shown at the extreme left of the illustration.

Both beehive and byproduct coke are used for melting the iron. An exceptionally high grade coke, low in sulphur, being employed for use in the

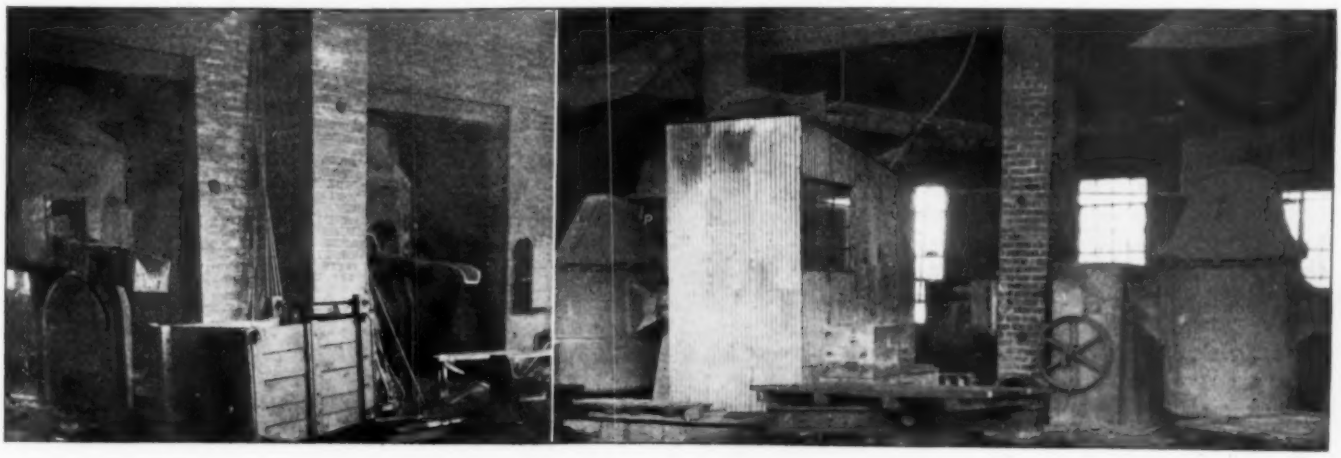

FIG. 5—THREE CUPOLAS ARE EMPLOYED FOR MELTING THE IRON FOR THE BESSEMER CONVERTERS FIG. 6—ONE BLOWER FURNISHES AIR FOR THE TWO VESSELS WHICH ARE USED ALTERNATELY—THE SMALL STRUCTURE IN THE CENTER IS THE MELTERS OFFICE AND OBSERVATION STATION

FIG. 7—THE DOORS FORM INTEGRAL PARTS OF THE CARS WHICH CONVEY THE STEEL CASTINGS INTO THE ANNEALING OVENS

cupola which melts the iron that later is transformed into steel in the converters.

The various uses to which the different castings entering into clay machinery are subjected make it necessary to pour them from different grades of iron. Some of the wearing parts are poured from hard white iron; others merely have certain surfaces chilled; others again must be extremely strong and hard yet machineable and still others come within the category known as ordinary machinery castings.

Approximately 500 pounds of coke are used for a bed, the melter using his discretion on this point and basing his decision on the quality of iron to be melted first and also upon the size and shape of the pieces of pig iron and scrap to be employed. The iron charges average 2000 pounds each; but this is not an arbitrary quantity and frequently is varied when only a comparatively small amount is needed for a special charge. The coke ratio works out about 1 to 8 and with a blast pressure of 15½ ounces it is stated that the cupola melts at the rate of 7 tons an hour. The flexibility achieved in the melting department and also the gratifying results obtained are due in a great measure to the supervision of the department by a practical man of wide and varied experience in the melting of iron and steel.

The hard, white iron always is melted first followed by other charges according to their relative hardness. Mixtures for six typical classes of castings follow:

(1) *Tires* which are the outside part of the wheels which come into direct contact with the material in the grinding pans are poured from a white iron mixture made up of 80 per cent white pig iron and 20 per cent return hard gates and risers.

(2) Large blocks requiring little or no machining, wheels inside the tires, etc., are made from an all scrap mixture to which a sufficient quantity of ferrosilicon and ferromanganese are added to show approximately 1.85 per cent silicon and 0.55 per cent manganese in the finished casting.

(3) Hard iron for chilled castings, augurs, etc., developing a tensile strength of 22,000 pounds per square inch and showing an analysis of 1.30 per cent silicon and 0.70 per cent manganese is made up of 40 per cent No. 2 foundry pig iron; 40 per cent bessemer steel scrap and 20 per cent miscellaneous shop scrap. These relative proportions are changed depending on the depth of chill required on any given casting.

(4) Semisteel for gears, the heavy bars carrying the knives in the pug mills, etc., and developing a tensile strength of 33,000 pounds per square inch and an ultimate analysis of 1.60 to 1.80 per cent silicon, and 0.50 to 0.70 per cent manganese is made up of 60 per cent No. 2 foundry pig iron, 20 per cent bessemer steel scrap and 20 per cent shop scrap. As in the case of the iron in the preceding mixture, the relative proportions may vary from time to time depending on the weight of the casting or on the thickness of metal section.

(5) Screens set in the bottom of the grinding pans must be made of hard, strong iron to withstand the abrasion of gritty material. The usual mixture contains 40 per cent No. 2 foundry pig iron, 20 per cent bessemer steel scrap, 20 per cent hard-iron gates and runners and 20 per cent car wheel rims.

(6) Internal combustion engine cylinders are made from a mixture comprising 25 per cent No. 1 charcoal iron, 17 per cent No. 2 foundry pig iron, 10 per cent car wheel centers, 23 per cent bessemer steel scrap, 25 per cent good machinery scrap. In addition to the foregoing, 5 pounds of 80 per cent ferromanganese and 3 pounds of 50 per cent ferrosilicon are added to each charge of 2000 pounds of iron in the cupola. These cylinders show the following average analysis: Silicon, 1.46 per cent, manganese, 0.60 per cent, sulphur, 0.116 per cent and phosphorus, 0.44 per cent.

### *Converter Practice*

A typical charge for the 36-inch cupola serving the bessemer converter is made up of 1200 pounds of low phosphorus pig iron, 300 pounds of steel heads and gates and 500 pounds of steel tube ends. This mixture will have an approximate silicon content of 2.00 per cent in the ladle before it is poured into the converter vessel. The vessel has a capacity of 4000 pounds and therefore it is necessary to tap into the ladle several times to accumulate the necessary amount. The ladle is mounted on a truck operating on a narrow gage track which terminates in a floor scale. When in the melter's opinion a sufficient quantity of metal is in the ladle it is pushed over on to the scale and weighed. Ad-

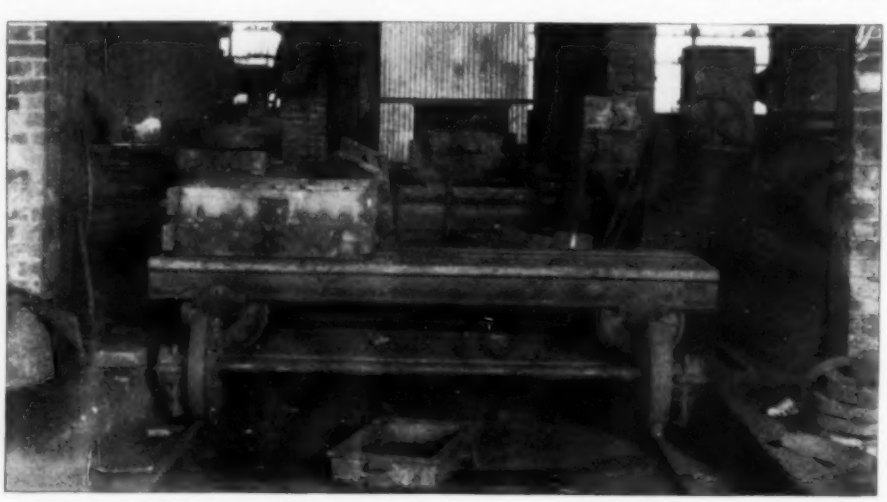

FIG. 8—A SMALL TRANSFER TRUCK OPERATING ON A DEPRESSED TRACK IS EMPLOYED FOR CONVEYING FLASKS AND PATTERNS INTO AND OUT OF THE FOUNDRY

ditional metal then is added until the proper amount is in the ladle. The ladle then is picked up by one of the cranes and the iron poured into the converter vessel.

While one heat is blowing the ladle is filling for the following heat. It rarely is necessary to weigh the ladle a second time. The mark left around inside the lining by the first ladle full is taken as a guide for subsequent operations. After the steel is blown, it is taken away from the converter in a teapot ladle and poured into the waiting molds.

A limited number of molds are made in green sand but the greater number are made in dry sand. A hard steel with carbon 0.50 to 0.70 per cent, silicon, 0.25 per cent, sulphur, 0.045 per cent, phosphorus, 0.021 per cent and manganese, 0.86 per cent is employed for making tires, wearing plates, etc. The ordinary run of castings are made from a steel of the following approximate analysis: Carbon, 0.18 per cent; silicon, 0.23 per cent; sulphur, 0.060 per cent; phosphorus, 0.021 per cent and manganese 0.78 per cent.

The main bay of the foundry is divided into three fairly well defined segregated areas; namely, the casting cleaning department, the iron molding department and the steel molding department. The entire bay is spanned by 4 electric traveling cranes, three having a capacity of 5 tons each, made by Pawling & Harnischfeger Co., Milwaukee, and the fourth with a lifting capacity of 20 tons.

### *Extensive Cleaning Room*

Part of the main floor used as a cleaning room is shown in Fig. 10. The large castings are chipped with pneumatic chisels and ground with portable pneumatic and electric grinders. Swinging grinders located close to the columns in the background also are employed for the same purpose. Several tumbling barrels and a sandblast chamber, made by the Pangborn Corp., Hagerstown, Md., complete the equipment in the cleaning room. The part of one of the side bays immediately adjoining the main cleaning room is utilized for cleaning the small castings.

FIG. 10—THE LARGE CASTINGS BOTH IRON AND STEEL, ARE CLEANED AT ONE END OF THE MAIN BAY—THE SMALLER CASTINGS ARE CLEANED IN ONE OF THE SIDE BAYS ADJOINING

From the limits of the cleaning room down to and including the space in front of the cupolas, the entire main bay and a considerable part of one of the side bays is devoted altogether to making the molds for and pouring the iron castings. A large jolt, rollover machine with a table 40 x 58 inches and another plain jolt machine with a table 60 x 72 inches both made by the Hermann Pneumatic Machine Co., Pittsburgh, are employed in the main bay for making many of the large molds. Two smaller machines made by the International Molding Machine Co., Chicago, are employed on the side floor in the same capacity. However, the greater part of the work both on the crane and side floor is rammed either by hand or by pneumatic rammers.

As a manufacturer of clay and sand mixing machinery it is only natural to find that the company has equipped its own shop liberally with mixing equipment and it is said that the remarkably smooth skin on the castings produced in the foundry is due as much to the manner in which the sand is prepared as it is to the quality of the sand and the skill of the workmen.

All the sand, whether intended for facing or cores is dried in one of the ovens before it is mixed. The different component parts are then placed in one of the several grinding pans provided for the purpose where the mixture is thoroughly blended.

### *Mixing the Sand*

After the sand has been ground it is wet down either with water in the case of facing sand or with oil or some other form of liquid binder in the case of core sand and then shoveled into a revolving paddle type of mixer made by the Blystone Manufacturing Co., Cambridge Springs, Pa. From the mixer it passes through a riddle and is then ready for use. A special pan 9 feet in diameter is provided for mixing the ganister lining for the converters. Typical sand mixtures follow:

(1) *Green Sand facing for steel castings.* Old moldings sand, 5 parts; Zanesville sand, 2 parts; Sandusky sand, 1 part; sea coal, 1 part.

(2) *Green sand facing for steel castings.* Old molding sand, 5 parts; silica sand, 5 parts; clay, 1 part wet down with liquid core binder diluted in water.

(3) *Average cores.* Old cores, 2 parts; sharp sand, 1 part,; Zanesville sand, 2 parts; Sandusky sand, 2 parts; dry core binder, 1/3 part; wet with clay wash.

(4) *Small cores, stock cores, etc.* Sharp sand, 11 buckets; Zanesville sand,

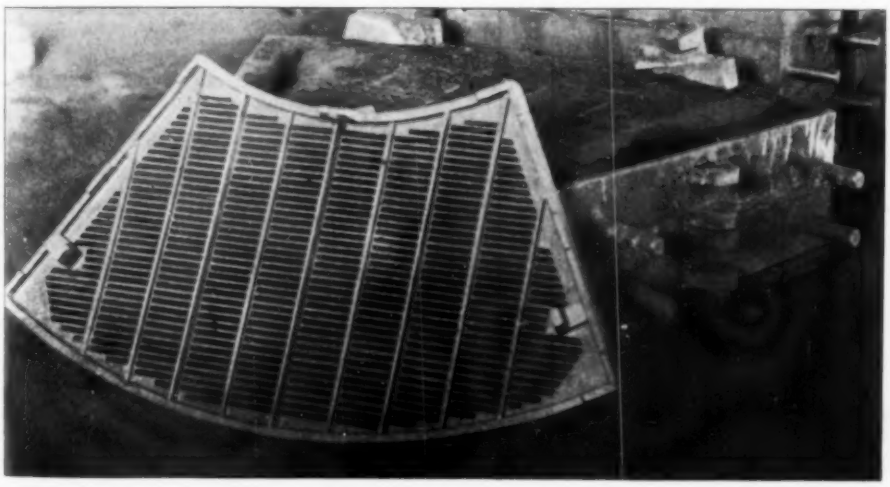

FIG. 9—THESE SCREENS, MADE OF A SPECIAL GRADE OF HARD IRON, ARE POURED THROUGH A ROW OF POP GATES IN THE BOTTOM OF A BASIN AT EACH END OF THE COPE

2 buckets; 1 gallon of core oil made by the Werner G. Smith Co., Cleveland.

(5) *Small cores for steel castings.* Silica sand, 4 buckets; sharp sand, 4 buckets; rosin, ½ bucket; Zanesville sand, 4 buckets.

6) *Large cores for steel castings.* Silica sand, 10 parts; clay, 1 part; silica flour, 2 parts; wet with liquid core binder.

(7) *Facing sand for steel castings.* Old molding sand, 10 parts; silica sand, 5 parts; clay, 1 part; wet down with liquid core binder. The same mixture is employed for making cover cores and other cores of the same general character.

Two annealing ovens, shown in Fig. 7, are used for annealing the steel castings. These are fired at the back with soft coal. Three large drying ovens each 9½ x 12 x 20 feet are provided for drying the molds in which the steel castings are made.

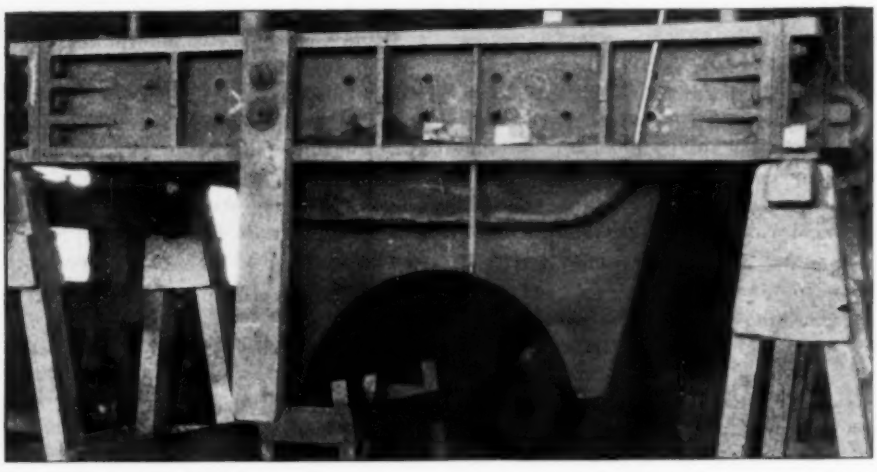

FIG. 10—SPECIAL ARBORS ATTACHED TO THE TOP OF THE COPE ARE EMPLOYED FOR SUPPORTING THE HANGING BODY OF SAND
FIG. 11—COPE FOR A FRAME SIMILAR TO THE ONE SHOWN AT *P*

The flasks used in the steel casting end of the foundry all are made of cast steel and the joints are machined to insure accuracy. To compensate for the distortion in these flasks, due to going into and out of the oven so often, one or two of the pin holes in the cope is made in the shape of a long slot extending to the edge of the lug. One hole each in the flange of the cope and drag correspond and help to locate the parts accurately. The remaining holes in the drag flange hold the pins in a definite position, but the slots in the cope lugs adjust themselves irrespective of whether the flasks are distorted or not.

The usual method for making these flasks is to lay off a level sand bed and then assemble a set of cores similar to those shown in Fig. 3. In the instance shown, a rectangular frame the required shape and size is laid on the bed and the inside filled and rammed full of green sand. The frame is then removed and the four cores assembled around the body of green sand It will be noted that several small lugs are attached to the sides of the cores. These small cores cut through the thickness of metal and furnish holes for bolting the cross bars if the flask is to be used as a cope. A small round core in the flange under the point marked *B* in the illustration leaves the necessary pin hole while a second core in the flange under the point marked *C* leaves a slot the full width of the flange. The openings at *D* and *D* are the runners. After the cores are assembled, a frame in the shape of a large drag is placed around them and the intervening space filled with sand and rammed to hold them in position.

The round flask shown in Fig. 2 is made in a somewhat similar manner. The spider in the center is cast separately and may be attached to the ring by a few bolts or clamped to the top flange by the flat pads which extend out over the top flange. If a ring pattern is available, the inside of the mold is rammed in green sand and the exterior formed in cores as in the case of the rectangular flask described in a preceding paragraph. In the event that no ring pattern is available, the exterior set of cores is assembled, then a set of plain segment cores is set up against them on the inside after which the open space in the center is rammed full of green sand. A large ring is lowered into place around the exterior set of cores and then the space between the cores and the ring filled with sand and rammed.

One of the advantages of this style of flask is that it can be converted into a cope or drag at will, a feature that is appreciated by those who find it necessary to build several large drags on top of each other for exceptionally high patterns. Where many large risers are necessary on a casting, this style of flask facilitates the shaking out operation. It is only necessary to loosen the bolts or clamps and the ring can be removed leaving the spider in place among the risers. With free access to the risers all around, it is much easier to remove the spider after the ring has been taken away.

One core room, located in a leanto at the right of the converters, serves both the iron and the steel molders. It is provided with a large and a small core oven fired with coke and also with a shelf-oven, fired with oil. A track extending from the large oven across the core room floor and into the main bay of the foundry is employed to convey the large cores from the oven to where they can be picked up by one of the electric traveling cranes. A monorail extending from end to end of the core room is equipped with a small hoist made by the Euclid Crane & Hoist Co., Euclid, O, which enables the coremakers to handle cores weighing several hundred pounds. The large cores are made in the main bay of the foundry and are loaded directly on the cars by one of the traveling cranes.

A large room, adequately lighted and heated, has been fitted up close to the office and laboratory as a wash and locker room for the workmen. In addition to a double row of wash bowls supplied with hot and cold water extending down the center of the floor, several shower baths are provided.

Close to the wash room on the outside, a depressed track shown in Fig. 8 enters the foundry. The truck operating on this track is employed for carrying flasks in and out of the shop and also for conveying patterns from the foundry to the pattern storage which is located several hundred yards away.

The power house is situated in part of the side bay opposite the annealing ovens shown in Fig. 7. Steam from the boiler is utilized for heating the building and also for operating a direct steam driven cross compound Laidlaw air compressor with cylinders 10 x 17 and 15 x 9½ x 12 inches. Other equipment includes a 200-kilowatt, General Electric, rotary generator for crane service and a 200-kilowatt, Westinghouse turbo-generator which is held as a spare. Electric power is supplied by the city.

# Heat Treatment Improves Castings

## Tensile Tests of Unannealed, Air Cooled and Water Quenched Steel Castings Do Not Disclose Marked Difference in Strength but Impact Tests Show Water Quenched Product Excels the Others

BY MARTIN M. ROCK

CONSIDERING the abundant literature on the subject of heat treating steel, it is surprising that so few references are made to steel castings. Probably the fact that the great majority of articles on heat treatment deals with forged or rolled material is due to the prevalent belief in many quarters that a certain treatment for mechanically worked material will give equally satisfactory results on cast steel of similar composition, or that cast steel does not respond to heat treating except to the simplest forms of annealing. Many steel castings made today are used in the unannealed condition and where annealing is done it usually consists of heating to a temperature above the critical range, soaking at that temperature and cooling slowly in furnace.

The temperature to which the castings are heated and the length of the soaking period vary in different foundries there being no standard practice. In many shops no pyrometers are used, the temperature being gaged by the eye.

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Authorities have recognized that an improvement in the quality of cast steel could be obtained by proper heat treatment. It now is well understood that cast steel must undergo a more vigorous preliminary heating than forged steel, in order to break up the original coarse crystalline structure, which in the case of forged metal has been broken up by the mechanical treatment. Instead of heating to a temperature slightly above the $AC_1$ point during a short period, as in the case of forging, it is necessary to heat cast steel to a higher temperature and allow it to soak for a considerable time, depending upon the size of the casting. After the steel has been normalized the heat treatment may be the same as for forgings.

A number of tests made by the Geo. H. Smith Steel Casting Co., Milwaukee, on sideblow converter steel, confirm the idea that heat treated cast steel is superior to the annealed and that annealed is superior to the unannealed. The heat treatment, consisted of heating the steel for a period of 4 hours at 1650 degrees Fahr. and quickly cooling it either in air or water and subsequently drawing for 2 to 3 hours at 1220 to 1250 degrees Fahr. The annealing treatment consisted of heating for 4 hours at 1650 degrees Fahr., cooling in the furnace.

The first tests were to determine the tensile strength of cast steel treated as follows: Unannealed, annealed, air cooled and drawn, and water quenched and drawn. In most cases steel from the same heat was given two different treatments. Some samples from heats Nos. 2503, 2554, and 2600 were unannealed while others were annealed; 2378, 2518, 2577, and 2611, unannealed and water quenched; and 2644, 2656, 2667, and 2676 annealed and air cooled. Direct comparison can be made from Table I as to the effect of the treatments.

The tensile tests do not indicate a marked difference between the various treatments. Annealed steel is shown to have a greater ductility and some-

### Table I

### Tensile Tests on Common Steel Castings

| Heat No. | Carbon | Manganese | Yield point | Tensile strength | Elongation 2 in. | Reduction in area |
|---|---|---|---|---|---|---|
| NOT ANNEALED | | | | | | |
| 1936-H | .21 | .58 | 42,750 | 71,000 | 28.0 | 40.5 |
| 2378-1 | .28 | .92 | 70,000 | 79,500 | 20.0 | 23.0 |
| 2503-1 | .27 | .88 | 50,750 | 80,750 | 16.5 | 16.3 |
| 2503-2 | .27 | .88 | 45,500 | 81,750 | 19.0 | 19.9 |
| 2518-1 | .24 | .64 | 41,000 | 75,750 | 22.0 | 24.9 |
| 2518-2 | .24 | .64 | 44,000 | 75,750 | 22.5 | 24.1 |
| 2554-1 | .24 | .77 | 41,000 | 75,000 | 21.0 | 21.3 |
| 2554-2 | .24 | .77 | 44,500 | 76,750 | 16.0 | 15.9 |
| 2577-1 | .22 | .71 | 47,000 | 77,000 | 21.5 | 29.1 |
| 2577-2 | .22 | .71 | 49,000 | 76,500 | 28.0 | 38.8 |
| 2600-1 | .21 | .71 | 43,000 | 70,500 | 27.0 | 35.4 |
| 2611-1 | .21 | .65 | 42,000 | 70,500 | 22.5 | 23.0 |
| 2611-2 | .21 | .65 | 41,250 | 69,500 | 22.5 | 23.4 |
| Average .. | .24 | .68 | 46,288 | 75,404 | 22.1 | 25.8 |
| STRAIGHT ANNEAL | | | | | | |
| 1969-c | .23 | .83 | 45,500 | 75,500 | 28.0 | 42.5 |
| 1969-H | .23 | .83 | 45,000 | 76,000 | 22.0 | 24.9 |
| 2005-C | .25 | .75 | 41,500 | 76,250 | 29.0 | 46.9 |
| 2005-H | .25 | .75 | 40,250 | 72,750 | 30.0 | 47.4 |
| 2005-HS | .25 | .75 | 42,750 | 72,750 | 28.5 | 42.5 |
| 2048-HC | .24 | .66 | 41,250 | 69,250 | 29.0 | 48.6 |
| 2048-HR | .24 | .66 | 41,750 | 68,750 | 30.0 | 51.4 |
| 2052-H | .24 | .77 | 41,500 | 73,000 | 28.5 | 39.8 |
| 2052-C | .24 | .77 | 40,500 | 73,250 | 27.0 | 41.3 |
| 1714 | .22 | .69 | 43,500 | 73,500 | 29.5 | 50.1 |
| 1714 | .22 | .69 | 45,500 | 74,250 | 30.0 | 33.4 |
| 1714 | .22 | .69 | 45,750 | 74,000 | 30.0 | 48.1 |
| 1714 | .22 | .69 | 42,740 | 74,300 | 30.5 | 48.6 |
| 1714 | .22 | .69 | 44,140 | 74,350 | 32.0 | 50.0 |
| 1714 | .22 | .69 | 44,090 | 74,700 | 29.5 | 42.5 |
| 2378-2 | .28 | .92 | 48,000 | 77,500 | 29.5 | 41.9 |
| 2503-3 | .27 | .88 | 51,750 | 81,000 | 24.5 | 33.4 |
| 2503-4 | .27 | .88 | 49,500 | 80,500 | 26.5 | 35.4 |
| 2554-3 | .24 | .77 | 45,000 | 73,250 | 31.0 | 46.9 |
| 2554-4 | .24 | .77 | 41,750 | 73,750 | 31.0 | 49.2 |
| 2600-2 | .21 | .71 | 40,500 | 70,000 | 31.5 | 51.2 |
| 2600-3 | .21 | .71 | 42,000 | 70,000 | 33.5 | 51.4 |
| 2644-1 | .20 | .62 | 42,050 | 69,950 | 32.0 | 42.5 |
| 2644-2 | .20 | .62 | 40,800 | 69,550 | 30.5 | 52.0 |
| 2656-1 | .23 | .60 | 44,250 | 74,100 | 30.5 | 50.5 |
| 2656-2 | .23 | .60 | 43,600 | 74,050 | 28.5 | 47.5 |
| 2667-1 | .24 | .71 | 41,700 | 71,950 | 27.5 | 44.0 |
| 2667-2 | .24 | .71 | 42,900 | 71,700 | 29.0 | 43.5 |
| 2676-1 | .21 | .58 | 42,550 | 71,800 | 24.0 | 29.0 |
| 2676-2 | .21 | .58 | 43,500 | 71,950 | 27.5 | 42.0 |
| Average .. | .23 | .71 | 43,319 | 73,455 | 29.0 | 43.9 |
| WATER QUENCHED AND DRAWN | | | | | | |
| 2378-3 | .28 | .92 | 60,500 | 89,250 | 30.0 | 44.9 |
| 2518-3 | .24 | .64 | 46,750 | 75,000 | 31.0 | 55.8 |
| 2518-4 | .24 | .64 | 59,000 | 75,750 | 31.5 | 57.5 |
| 2577-3 | .22 | .71 | 54,000 | 75,500 | 31.0 | 56.3 |
| 2577-4 | .22 | .71 | 51,750 | 75,500 | 30.5 | 59.5 |
| 2611-3 | .21 | .65 | 48,500 | 70,750 | 32.5 | 56.0 |
| 2611-4 | .21 | .65 | 46,500 | 72,500 | 29.0 | 53.9 |
| Average .. | .23 | .70 | 54,429 | 76,321 | 30.8 | 54.8 |
| AIR COOLED AND DRAWN | | | | | | |
| 2644-3 | .20 | .62 | 40,600 | 66,900 | 32.5 | 50.5 |
| 2644-4 | .20 | .62 | 42,100 | 67,950 | 32.0 | 53.5 |
| 2656-3 | .23 | .60 | 43,850 | 70,850 | 32.0 | 53.5 |
| 2656-4 | .23 | .60 | 42,650 | 70,850 | 32.5 | 55.5 |
| 2667-3 | .24 | .71 | 42,950 | 68,800 | 32.5 | 54.0 |
| 2667-4 | .24 | .71 | 41,600 | 68,950 | 32.5 | 53.5 |
| 2676-3 | .21 | .58 | 43,050 | 68,550 | 32.0 | 50.5 |
| 2676-4 | .21 | .58 | 43,250 | 69,350 | 28.5 | 40.5 |
| Average .. | .22 | .63 | 42,506 | 69,025 | 31.8 | 51.4 |

## Table II

## Results of Tests on Russell Impact Machine

*Heat No. 3025: Carbon, 0.26; Silicon, 0.52; Sulphur, 0.065; Phosphorus, 0.068; Manganese, 0.63*

| Specimen number | Heat treatment | Yield point | Tensile strength | Elongation in 2 inches | Reduction of area | Russell notch bar, impact. inch, pounds |
|---|---|---|---|---|---|---|
| 3025-1-1 | Slow cool | 43350 | 76400 | 27.0 | 35.0 | 198 |
| 3025-1-2 | Slow cool | 44950 | 78100 | 26.5 | 40.2 | 213 |
| 3025-1-3 | Water quench and draw | 46300 | 80450 | 19.0* | 32.0 | 300 |
| 3025-1-4 | Water quench and draw | 46250 | 79900 | 24.0 | 34.0 | 284 |

*Flaw.

The quench draw treatment increases the notched-bar impact strength over 40 per cent.

CHEMICAL ANALYSES AND TENSILE TESTS

| Specimen number | Elastic limit | Ultimate strength | Elongation in 2 inch. | Reduction area |
|---|---|---|---|---|
| *Heat 4274: Carbon, 0.18; silicon, 0.44; sulphur, 0.070; and manganese, 0.76.* | | | | |
| 4274-1 | 33000 | 76500 | 12 | 20.2 |
| 4274-2 | 38850 | 78000 | 23 | 26.8 |
| 4274-3 | 36750 | 71500 | 26.8 | 41.6 |
| *Heat 4296: Carbon 0.24; silicon, 0.41; sulphur, 0.058; and manganese, 0.80.* | | | | |
| 4296-1 | 36.250 | 84.000 | 15 | 12.6 |
| 4296-2 | 35.700 | 82.750 | 25 | 35 |
| 4296-3 | 35.750 | 77.500 | 28 | 37.6 |
| 4296-4 | 39.750 | 81.750 | 27 | 42.5 |
| *Heat 4333: Carbon, 0.25; silicon, 0.44; sulphur, 0.057; and manganese, 0.82.* | | | | |
| 4333-1 | 36.250 | 84.000 | 15 | 12.6 |
| 4333-2 | 35.750 | 82.750 | 25 | 35 |
| 4333-3 | 35.750 | 77.500 | 28 | 37.6 |
| 4333-4 | 39.750 | 81.750 | 27 | 42.5 |

what lower tensile strength and elastic limit than the unannealed. The principal advantage of the former treatment is the greater uniformity. Cast steel which has been air cooled and drawn has greater ductility and lower ultimate and elastic limits than the annealed material, while the water quenched product is superior in all these qualities.

Impact tests, however, show the advantages between the different methods of treatment. The first notch bar impact tests were made by the University of Wisconsin on a Russell impact machine.

### *Water Quenching Gives Fine Grain*

In these tests only the annealed and water quenched bars were tested. Table II gives summary of the test. Photomicrographs of the bars showed a fine grain for the water quenched and a coarser grain with some traces of the original ingotism in the annealed bars.

The impact tests on the next series of bars were made by George F. Comstock, Titanium Alloy Co., Niagara Falls, N. Y. The purpose of this test was not only to show the different methods of heat treatment but also to determine the effect of the dendrites revealed by macroscopic etching. Mr. Comstock's report is as follows:

Twenty steel bars machined 10 millimeters square and about 3 inches long were used for the impact tests. The bars had been cut from the centers of the sides of four special rectangular castings from titanium-treated heat 3322, which contained 0.22 per cent carbon and 0.54 per cent manganese. Two of the castings were made of hot metal at the beginning of the pour, and the other two of colder metal later on. The hot-cast bars had a distinct dendritic macrostructure, with parallel dendrites running across one side; the cold-cast bars however showed a more regular network macrostructure without dendrites.

The bars were notched with a hacksaw for testing on a pendulum machine of the Izod type. The notches were each 3 millimeters deep, and 28 millimeters from the end of the bar. In making a test, the knife-edge on the pendulum broke the ends off the bar, and was swung toward the notched side of it. The bars which had dendritic structures were marked when received so that the notches for testing were cut parallel to the dendrites on some, and perpendicular on others. In this way it was hoped to determine the influence of the dendrites on the impact resistance. The bars also represented various heat treatments. In this manner the influence of heat treatment on the impact resistance was shown also. The tests were made with a blow of 200 foot-pounds, the readings being the respective differences between this total force developed and the force remaining in the pendulum after breaking the bars. Two tests were made on each bar and the results are given in Table III. The annealing mentioned in this table consisted of heating for four hours at 1650 degrees Fahr., followed by slow cooling in the furnace. The quenching was done in water.

### *Little Effect From Dendrites*

The results do not show any striking effects of the dendrites on the impact resistance; in fact the specimens without dendrites were inferior to those with them. The tests made parallel to the dendrites gave slightly better results than those made crosswise, except in the case of the double heat treated bars where there was no difference. The effects of the heat treatments were more marked, as the unannealed bars were brittle, and the double heat treated bars were decidedly tougher than those that were simply annealed. However, no difference in effect was shown between air-cooling and water quenching as the first operation of the double heat treatment.

A number of the bars were etched

## Table III

## Results of Izod Impact Tests to Determine Effect of Dendrites

| Bar No. | Casting temperature | Heat treatment | Direction of dendrites in relation to blow | Foot pounds required to break | Average results |
|---|---|---|---|---|---|
| 1 | Hot | Not annealed | Parallel | 5-7 | 5.25 |
| 2 | Hot | Not annealed | Parallel | 4-5 | |
| 3 | Hot | Not annealed | Perpendicular | 5-4 | |
| 4 | Hot | Not annealed | Perpendicular | 4-4 | |
| 5 | Hot | Annealed | Parallel | 22-22 | 20.00 |
| 6 | Hot | Annealed | Parallel | 17-19 | |
| 7 | Hot | Annealed | Perpendicular | 18-17 | 18.00 |
| 8 | Hot | Annealed | Perpendicular | 19-18 | |
| 9 | Hot | Air cooled and drawn | Parallel | 24-25 | 24.50 |
| 10 | Hot | Air cooled and drawn | Perpendicular | 25-25 | 25.00 |
| 11 | Hot | Quenched and drawn | Parallel | 24-27 | 25.50 |
| 12 | Hot | Quenched and drawn | Perpendicular | 27-24 | 25.50 |
| 13 | Cold | Not annealed | No dendrites | 5-4 | |
| 14 | Cold | Not annealed | No dendrites | 6-5 | 5.00 |
| 15 | Cold | Annealed | No dendrites | 13-17 | |
| 16 | Cold | Annealed | No dendrites | 16-18 | 16.00 |
| 17 | Cold | Air cooled and drawn | No dendrites | 23-26 | |
| 18 | Cold | Quenched and drawn | No dendrites | 18-21 | 22.00 |
| 19 | Cold | Quenched and drawn | No dendrites | 18-19 | |
| 20 | Cold | Air cooled and drawn | No dendrites | 23-24 | 21.00 |

after testing to check the direction of the dendrites and to make sure that no error had occurred in marking the sides to be notched. The dendrites were found to extend in the proper direction in each of the tested bars.

A third set of bars was sent to the University of Illinois to be tested on a Charpy machine with a standard notch as recommended by the United States bureau of standards. This notch was 0.079 inch deep, and the end of the notch was rounded to .01 inch radius with sides at an angle of 45 degrees.

The test specimens tested were cut from 11 bars of cast steel, three specimens being cut from each bar. The testing machine used was a Charpy impact machine of 30 meter-kilograms capacity. The results obtained are shown in Table IV.

### *Heat Treated Bars Excel*

The tensile tests on these three steels show results similar to those given in the first series of tests. The impact tests indicate a decided difference between the various heat treatments. The unannealed bars have a low impact value while the annealed bars show an average value nearly 72 per cent higher. The air cooled bars average 100 per cent better than the annealed, while the water cooled average 60 per cent better than air cooled. A discrepancy is apparent between these results and those obtained by Mr. Comstock who found that there was no difference between the air cooled and the water quenched. The explanation is to be found in the fact that the bars sent to him were machined almost to size before heat treatment, and were consequently small. The bars sent to the University of Illinois were of a large size when heat treated. The small bars cooled almost as rapidly in the air as in the water so that the results were practically the same. The rapidity of cooling and not the quenching medium effects the change. The high impact value of the water quenched steel compares favorably with that of heat treated forged alloy steels.

### *Conclusions*

From these tests it is evident that a decided improvement in the quality of cast steel can be brought about by proper heat treatment, this being shown in a more advanced degree by notch bar impact tests than by static tests. Water quenching of castings is liable to cause cracks, especially in the more intricate designs. This also is true of forgings. Large size castings cannot be cooled so rapidly as small ones and therefore the benefit derived from the quenching is less. Government specifications do not permit water quenching of castings except in certain special cases to be authorized by the inspector. This is to avoid the danger of cracking, but there is no reason why castings of medium or small size and simple design cannot be quenched without danger.

Benefits derived from air cooling over straight annealing are sufficient so that where water quenching cannot be employed air cooling should be used to avoid the danger of cracking. The author believes the time is coming when no steel castings will be used in the unannealed state except those for magnetic circuits in the electrical industry. The heat treatment which gives the best result will be the one to be used.

All the tests mentioned were of low carbon steel. High carbon steel is more responsive to heat treatment and the effect is more marked. Alloy cast steel heat treated shows most favorable physical properties and no doubt more elaborate heating methods would show better results. The subject is one that would repay extensive research work.

---

The Triumph Electric Co., Cincinnati, manufacturer of motors, has removed its Philadelphia office to 609 Arch street. Arthur H. Allen, district manager is in charge.

## Table IV
## Results of Impact Tests on Charpy Machine

| Speciment from bar marked | | Energy of rupture foot pounds | Character of fracture |
|---|---|---|---|
| 4333-1 | Not annealed | 4.39<br>4.28<br>3.56 | Coarse crystalline |
| | Average | 4.08 | |
| 4333-2 | Slow cool | 8.20<br>8.70 | Medium fine crystalline |
| | | 8.45* | |
| 4333-3 | Air | 13.50<br>16.64<br>14.46 | Fine crystalline |
| | | 14.87* | |
| 4333-4 | Water | 23.46<br>26.12<br>25.14 | Jagged |
| | | 24.91* | |
| 4296-1 | Not annealed | 3.40<br>3.64<br>3.48 | Coarse crystalline |
| | | 3.51* | |
| 4296-2 | Slow cool | 5.92<br>6.82<br>5.02 | Medium fine crystalline |
| | | 5.92* | |
| 4296-3 | Air | 12.00<br>16.76<br>17.36 | Medium fine crystalline |
| | | 15.37* | |
| 4296-4 | Water | 21.16<br>18.42<br>25.00 | Fine crystalline |
| | | 21.53* | |
| 4274-1 | Not annealed | 5.20<br>3.96<br>5.29 | Coarse crystalline |
| | | 4.82* | |
| 4274-2 | Slow cool | 6.19<br>6.73<br>8.00 | Medium fine crystalline |
| | | 6.97* | |
| 4274-3 | Air | 12.41<br>13.11<br>13.74 | Fine crystalline |
| | | 13.09* | |

*Average value.

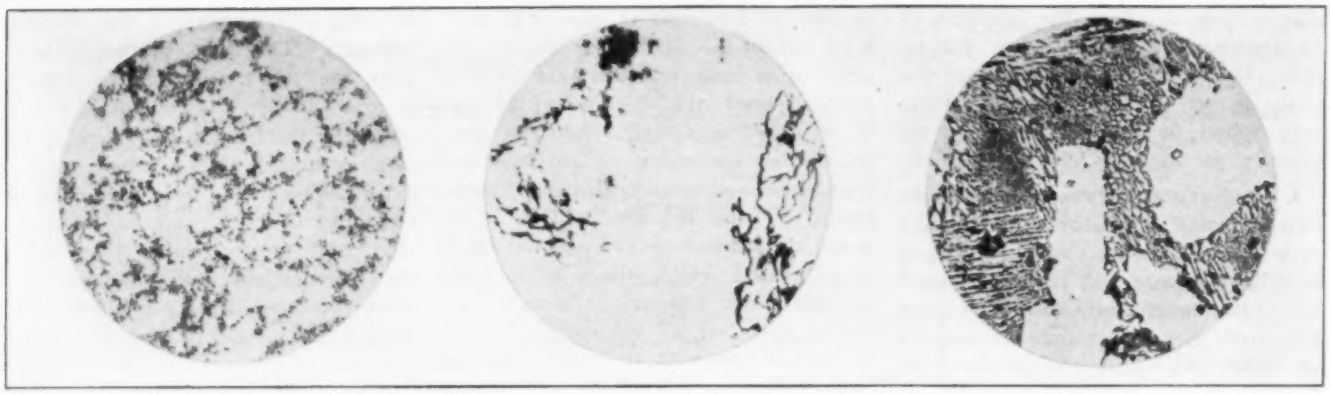


FIG. 1—ALUMINA IN ALUMINUM BRONZE—UNETCHED—X 200 DIA.

FIG. 2—UNSOUND SPOT—UNETCHED—X 200 DIA.

FIG. 3—COARSE ALPHA-BETA STRUCTURE WITH LAMELLAR BETA —X 200 DIA.

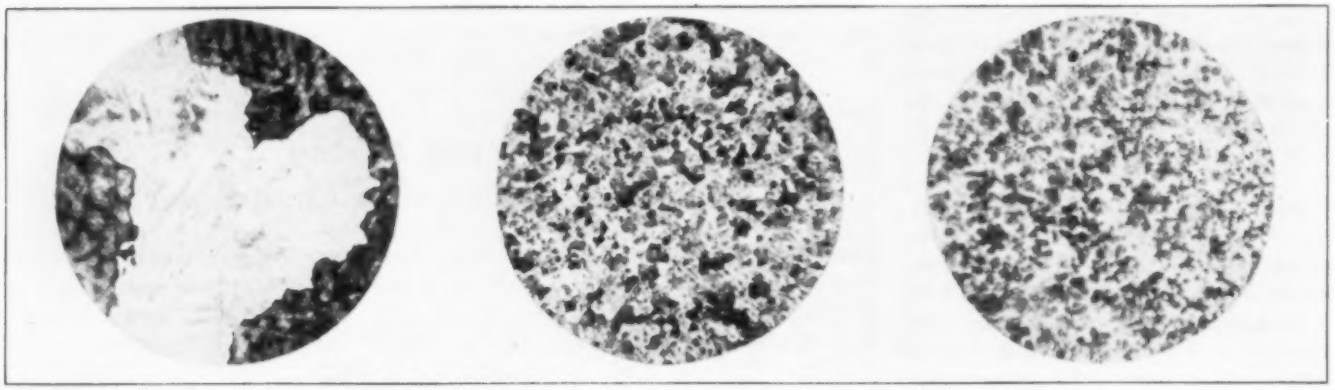


FIG. 4—SEVEN PER CENT ALUMINUM, 1 PER CENT IRON—X 20 DIA.

FIG. 5—SEVEN PER CENT ALUMINUM, 4 PER CENT IRON—X 20 DIA.

FIG. 6—SEVEN PER CENT ALUMINUM, 8 PER CENT IRON—X 20 DIA.

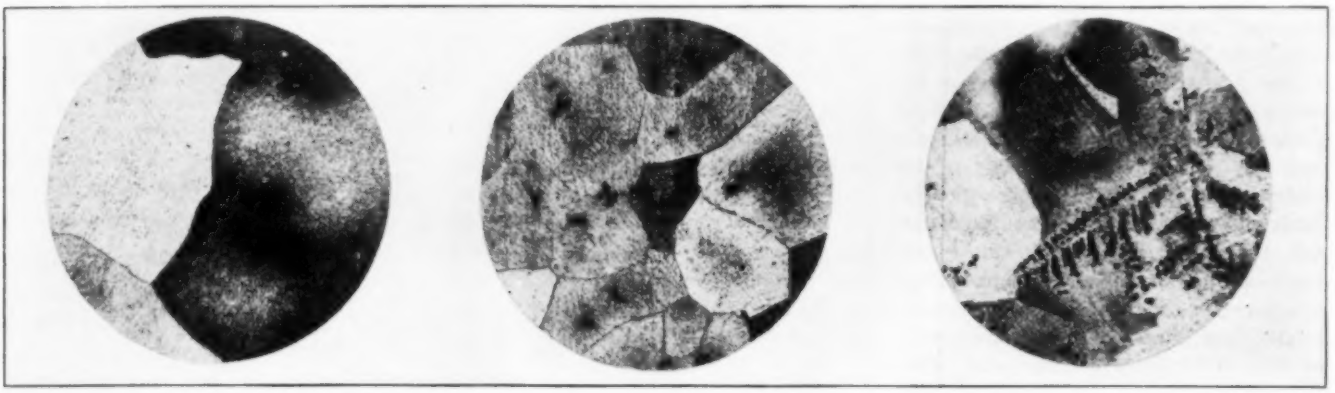


FIG. 7—SAME AS FIG. 4 BUT MAGNIFIED 200 DIA.

FIG. 8—SAME AS FIG. 5 BUT MAGNIFIED 200 DIA.

FIG. 9—SAME AS FIG 6 BUT MAGNIFIED 200 DIA.

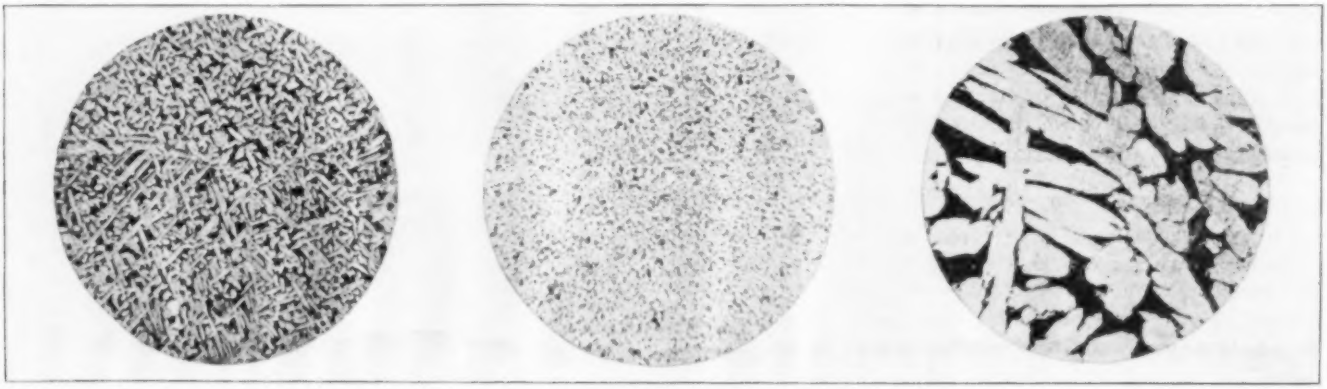


FIG. 10—TEN PER CENT ALUMINUM, 1 PER CENT IRON, SAND-CAST, —X 20 DIA.

FIG. 11—TEN PER CENT ALUMINUM, 8 PER CENT IRON—X 20 DIA.

FIG. 12—SAME AS FIG. 10 BUT MAGNIFIED 200 DIA.

# Notes on Casting Aluminum Bronze

## Micrographs Illustrate Effects of Different Compositions and Heat Treatments on the Structure—Presence of Manganese Tends To Refine the Grain

BY AUSTIN D. WILSON

WITHIN the past few years aluminum bronze has come into prominence as one of the most important of the nonferrous alloys. By aluminum bronze is meant those alloys near the copper end of the series containing less than 12 per cent of aluminum and usually, but not necessarily, a small percentage of iron.

Of all the bronzes these are most like steel. Their composition may vary within wide limits as may their method of manufacture and an aluminum bronze may be found for almost every purpose. They are sensitive to slight variations in composition and respond readily to heat treatment. They may be used as cast, rolled or forged. This article in a general way gives an insight into the metallography, physical properties and uses of the more important of the aluminum bronzes.

Probably the hardest problem with which the maker of bronzes has to contend is that of making good castings of aluminum bronze. For instance, the gating of castings of this material is entirely different from that of any other bronze, as also is the placing and size of the risers. In addition, the casting temperature is higher. This tends to the absorption of gases and consequently unsound castings full of blowholes. Without the use of a suitable deoxidizer it is impossible to obtain sound castings of aluminum bronze. The reasons for this are twofold: First, as already mentioned, the absorption of gases; and second, the formation of alumina, oxide of aluminum or $Al_2O_3$, caused by the oxidization of a part of the aluminum which is in the metal.

This oxidation takes place readily and the resulting alumina causes the metal to become thick and pasty and to entrap any particles of foreign matter which might otherwise rise to the top and be skimmed off. Likewise, the particles of $Al_2O_3$ remain in the metal causing hard spots, which are injurious to cutting tools. Fig. 1 shows a group of alumina inclusions in a casting which gave trouble in machinery. Under the microscope these inclusions appear to have a bluish-gray center. Fig. 2 shows a view of an unsound spot caused by the absorption of gases. These samples were unetched, all other micrographs shown in this article were etched with $FeCl_3$.

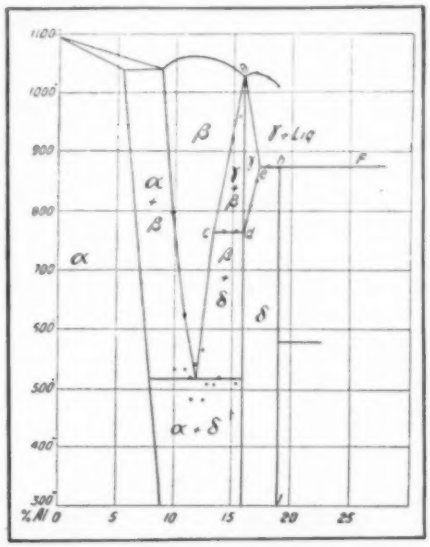



FIG. 13—COPPER-ALUMINUM EQUILIBRIUM DIAGRAM

Before proceeding further it would be well to briefly discuss the diagram of thermal equilibrium of copper-aluminum alloys, a portion of which is shown in Fig. 13. From this it may be seen that all alloys of copper and aluminum of 8.5 per cent aluminum and under have but one constituent, alpha, when at atmospheric temperature, if cooled normally. It may also be seen that alloys of this composition solidify as typical solid solutions, selective freezing taking place. In alloys of less than 5.5 per cent no further change occurs, but in alloys of from 5.5 to 8.5 per cent aluminum a range of temperature is passed through in which a second constituent, beta is formed. However, on continued cooling, this constituent is absorbed and the metal is again composed solely of alpha. Alloys containing more than 8.5 per cent aluminum up to 12 per cent, which is as high as is necessary to be considered here, solidify in a much different manner. They have no freezing range but solidify instantly on dropping below their liquidus, consequently allowing of no selective freezing. The constituent, beta, thus formed is unstable and on further normal cooling alpha is precipitated, giving rise to a typical duplex structure which is stable and is the normal condition for a sand-cast bronze of this composition.

The author is metallographist, the Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

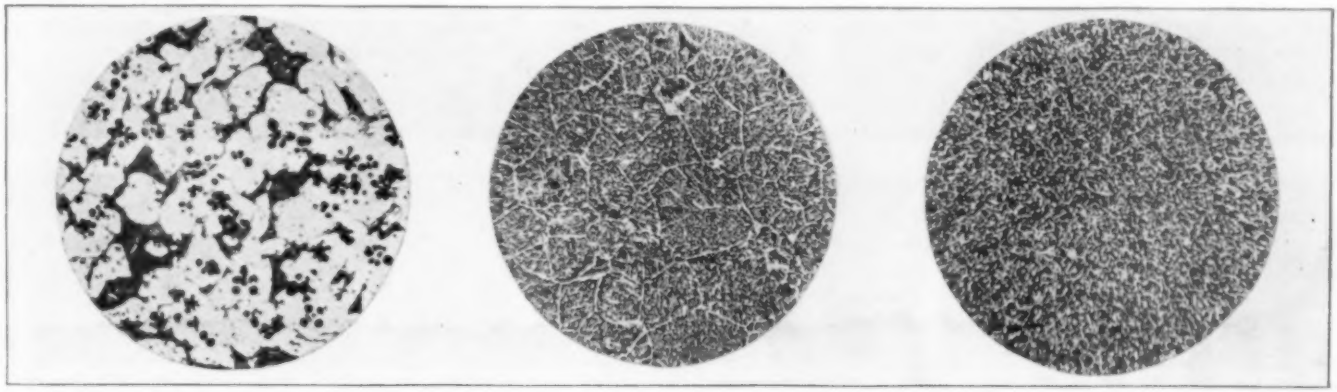


FIG 14—SAME AS FIG. 11 BUT MAGNIFIED 200 DIA.

FIG. 15—ELEVEN PER CENT ALUMINUM, 5 PER CENT IRON—X 20 DIA.

FIG. 16—ELEVEN PER CENT ALUMINUM; 5, IRON; 2, MANGANESE—X 200

FIG. 17—TEN PER CENT ALUMINUM, 1 PER CENT IRON—AFTER QUENCHING FROM 925 DEGREES CENT. —X 200 DIA.

FIG. 18—AFTER QUENCHING FROM 700 DEGREES CENT.—X 200 DIA.

FIG. 19—HELD FOR 10 SECONDS IN AIR AND THEN QUENCHED—X 200 DIA.

However, if the cooling to room temperature is abnormally slow the beta to alpha-beta transformation is followed at a temperature of about 500 degrees Cent. by another. In this latter transformation the remaining beta breaks down into an eutectoid of alpha plus delta as described by the author in an article on Self-Annealing in Aluminum Bronze, published in THE FOUNDRY, Oct. 1, 1920. As this results in poor physical properties and especially in excessive brittleness it is one of the chief hindrances in the way of making large castings of aluminum bronze. Fig. 4 illustrates the microstructure of a casting in which this has occurred.

The properties of the three constituents, alpha, beta and delta differ materially. Alpha is soft and ductile, whereas both beta and delta are hard and brittle, this being due in the beta to the presence of delta in solution.

Practically the only element purposely introduced in aluminum bronze outside of copper and aluminum is iron, and this has been found to so modify the physical properties of the alloy as to permit of its use over a wide range. The useful range for this series of copper-aluminum-iron alloys is from 7 to 10 per cent aluminum and 1 to 4 per cent iron. The properties which may be expected from alloys within this range are shown in Table 1. In

FIG. 20—REHEATED TO 500 DEGREES CENT. AFTER QUENCHING —X 200 DIA.

## Table I

### Effects of Iron on Physical Properties

| Alloy, per cent Al | Fe | Pounds per square inch—Yield point | Tensile strength | Elongation in 2 in., % | Reduction of area, % | Brinell hardness |
|---|---|---|---|---|---|---|
| 7 | 1 | 15700 | 53200 | 56.0 | 54.2 | 70 |
| 7 | 2 | 18900 | 63000 | 39.0 | 35.6 | 70 |
| 7 | 3 | 23300 | 74500 | 38.0 | 32.2 | 80 |
| 7 | 4 | 23600 | 76400 | 38.5 | 35.7 | 89 |
| 7 | 5 | 24700 | 73600 | 29.0 | 26.9 | |
| 7 | 6 | 25300 | 77500 | 31.5 | 27.6 | |
| 7 | 8 | 25600 | 74600 | 27.5 | 27.6 | |
| 8 | 1 | 19500 | 57100 | 45.0 | 43.4 | 70 |
| 8 | 2 | 20600 | 63800 | 39.0 | 39.2 | 80 |
| 8 | 3 | 26000 | 81100 | 36.5 | 32.9 | 109 |
| 8 | 4 | 26300 | 82100 | 35.0 | 32.9 | 109 |
| 9 | 1 | 23300 | 69500 | 43.0 | 35.7 | 77 |
| 9 | 2 | 25800 | 78300 | 30.5 | 27.4 | 109 |
| 9 | 3 | 28300 | 81700 | 26.0 | 26.9 | 109 |
| 9 | 4 | 28500 | 83000 | 23.0 | 23.8 | 109 |
| 10 | 1 | 24000 | 77000 | 24.5 | 25.2 | 94 |
| 10 | 2 | 26700 | 82600 | 21.0 | 19.2 | 100 |
| 10 | 3 | 28800 | 86400 | 20.0 | 20.5 | 109 |
| 10 | 4 | 30000 | 88600 | 17.0 | 18.5 | 119 |
| 10 | 5 | 33000 | 80600 | 12.5 | 16.9 | |
| 10 | 6 | 33500 | 85500 | 13.0 | 14.7 | |
| 10 | 8 | 35900 | 86500 | 11.5 | 12.4 | |

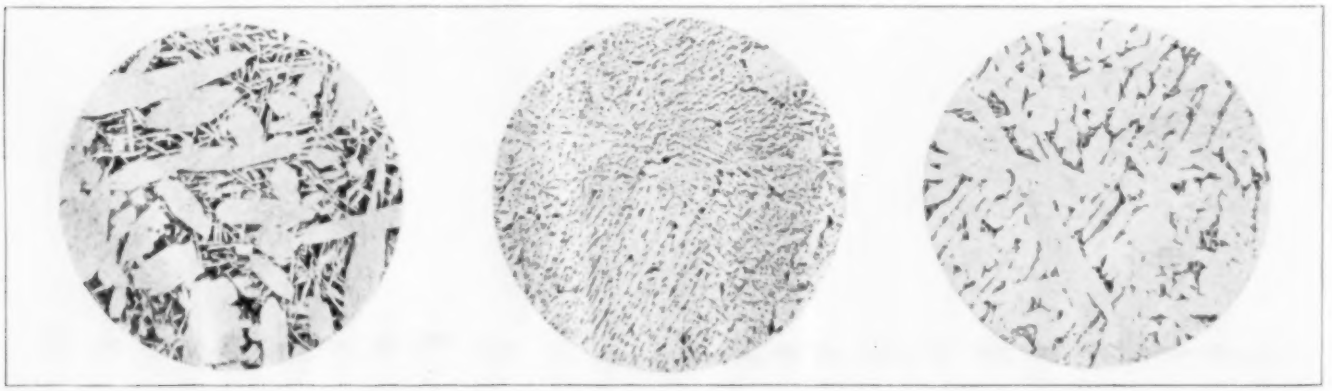


FIG. 21—REHEATED TO 700 DEGREES CENT. AFTER QUENCHING—X 200 DIA.

FIG. 22—REHEATED TO 625-650 DEGREES CENT. AFTER QUENCHING—X 200 DIA.

FIG. 23—STRUCTURE AT CENTER OF LARGE CASTING AFTER DOUBLE HEAT TREATMENT—X 200 DIA.

FIG. 24—CHILL-CAST—X 20 DIA. FIG. 25—DIE-CAST—X 20 DIA. FIG. 2 —FORGED—X 200 DIA.

the case of the 7 and 10-per cent aluminum alloys the results obtained with contents up to 8 per cent iron are shown although it is not considered advisable to attempt to make alloys of this type. With more than 4 per cent iron the physical properties are little better than with 4 per cent, but the casting difficulties are increased tremendously. It is well to consider 4 per cent iron as a maximum for aluminum bronze and when ductility is desired the aluminum content must not be much over 10 per cent.

An inspection of Table 1 will show that up to 4 per cent iron the increase in iron content is accompanied by an increase in both yield point and tensile strength, and a corresponding decrease in ductility. With more than 4 per cent iron the yield point continues to rise but the ultimate strength remains the same. The ductility drops sharply. For each increase in aluminum content the increase in yield point and tensile strength, and decrease in ductility is quite regular. The hardness number is raised with each increase in either aluminum or iron.

In making the tensile tests on the bars with low aluminum content it was noted that the surface of the bars containing a small percentage of iron roughened considerably under tension while those containing a high iron content remained smooth. The grains on some of the low-iron bars stood out markedly in relief.

A relief effect is always due to inhomogeneity of structure, and a consideration of the effect of the addition of iron on the microstructure of aluminum bronze readily explains the phenomenon. When added in amounts up to 1 per cent the iron is dissolved in the alpha solid solution, but when present in quantities much greater there is an excess of iron over that which the alpha can hold in solution. This excess forms an iron-rich compound with some of the copper and aluminum, and appears under the microscope as a bluish constituent. When present in small amounts this constituent appears in small dots which, as the iron is increased, become greater in number and size until well-defined crystallites are seen. This iron-aluminum-copper compound naturally freezes first and the particles form nuclei for the beginning of crystallization of the alpha crystals. Consequently the more iron present, the more of these centers of crystallization, with their resulting fineness of grain, are formed.

The roughness due to strain noticed in the bars of low iron content was due to the difference in relief in the large individual grains. Undoubtedly the same effect was present in the bars of higher iron content but due to the fineness of grain size the effect was not visible to the naked eye.

Figs. 4, 5 and 6, respectively, illustrate the effect upon the grain size of amounts of 1, 4 and 8 per cent iron on a 7-per cent aluminum bronze. Figs. 7, 8, and 9 show the same bronzes more highly magnified. Fig. 7 shows only alpha solid solution. The 1 per cent of iron is in solution. Fig. 8 shows small particles of the iron compound and Fig. 9 indicates well-defined crystals of it in a groundmass of alpha.

In a 10 per cent aluminum bronze the typical duplex alpha-beta structure is present. The iron does not seem to form such distinct crystals as in the bronze in which the groundmass is all alpha. It occurs mostly as rounded spots or as groups of rounded spots. It has the same effect on the grain size as noted before and, in addition, it seems to cause a decided change in the shape of the alpha crystals. The Widmanstatten, or cast structure, is broken up and the alpha crystals appear of a rounded or irregular shape and arranged with no regularity. This undoubtedly accounts for the better physical properties and more uniform fractures of the bars containing iron. Little difference in the microstructure of the bars containing 4 and 8 per cent iron was noticed, although both were different from that containing but 1 per cent. Figs. 10 and 11 show the difference in grain size between bars containing 1 and 8 per cent iron, respectively, while Figs. 12 and 14 show the same bars at a higher magnification. The difference can be plainly seen. The presence of manganese undoubt-

## Table II

### Relation of Microstructure to Physical Properties

| Micro-structure in Fig. | Treatment | Pounds per sq. in. Yield point | Tensile strength | Elongation in 2 in., % | Reduction of area, % | Brinell hardness |
|---|---|---|---|---|---|---|
| 13 | As cast | 24000 | 70000 | 22.0 | 24.0 | 100 |
| 17 | Quenched from 900° C. | 65000 | 105400 | 1.0 | 0.0 | 240 |
| 21 | Reheated to 700° C. | 27000 | 80000 | 23.0 | 21.7 | 104 |
| 20 | Reheated to 500° C. | 60000 | 96100 | 5.5 | 9.1 | 158 |
| 22 | Reheated to 625° C. | 45000 | 91200 | 12.5 | 15.0 | 143 |
| 23 | Reheated to 625° C. | 33000 | 74000 | 14.5 | 17.6 | 130 |

FIG. 27—SEVEN PER CENT ALUMINUM —FORGED—X 200 DIA.

edly increases the refining of the grain in the same manner as is shown in Figs. 15 and 16 which show a bronze containing 11 per cent aluminum and 5 per cent iron, the difference being that the bronze represented by Fig. 15 contains no manganese and that by Fig. 16 contains 2 per cent of manganese. In Fig. 15 a fine net work of alpha can be seen distinctly outlining the grains, but in Fig. 16 this is not apparent. The presence of more beta due to the higher aluminum content may also be noted.

The variations in microstructure caused by different heat treatments is clearly indicated and corresponds with the variations in physical properties. To illustrate this the writer has selected as best suited for this purpose a series of aluminum bronzes all of the same composition; aluminum 10 per cent and iron 1 per cent. In Table 2 the microstructures and physical properties are correlated.

On referring again to the diagram in Fig. 13 it may be seen that upon heating the sand-cast alloy, the microstructure of which is illustrated by Fig. 12, to above 800 degrees Cent. it enters the range where it is all in the form of beta, the excessively hard and brittle constituent. If now the cooling from this temperature be sufficiently rapid, such as quenching in water, all of the normal changes will be prevented, and the beta will be preserved at atmospheric temperature. Although theoretically this alloy is all transformed to beta on heating above 800 degrees Cent., to insure this change it is usual to heat to above 900 degrees Cent. before quenching. Fig. 17 shows the structure produced by this treatment. Note the typical acidular markings similar to martensite in steel. Fig. 18 shows a specimen quenched from 700 degrees Cent. which temperature was not high enough to allow of all the alpha being absorbed in the beta. The quenching must be done quickly and effectively if the maximum hardness is to be obtained as any delay in cooling below the transformation point will allow the almost instantaneous separation of some alpha. This is illustrated by Fig. 19, showing a specimen which was held 10 seconds before quenching.

*Heat Treat Bronzes*

Often, as in the treatment of steel, it is desired to obtain a high degree of strength, yield point, or hardness, together with a moderate degree of ductility. This is accomplished by subjecting the material to the hardening treatment just described and following this with a tempering treatment at a suitable temperature. The greater the ductility and the less the hardness or strength desired, the higher should the drawing temperature be.

This tempering is always done by heating the piece to the temperature desired and then cooling it slowly, either in the furnace or in lime. A consideration of Fig. 13 will show at once what this accomplishes. The metal at the beginning of the tempering operation is entirely in the beta condition and remains so during the heating but on cooling slowly through the lower transformation point the beta is transformed into its two constituents, alpha and delta, the alpha imparting to the metal its ductility and the delta strength and hardness. Fig. 20 shows a specimen reheated to 500 degrees Cent. Little separation of alpha and delta has occurred. Fig. 21 shows a specimen reheated to 700 degrees Cent. In this the benefits of the quenching have been almost entirely lost, large masses of soft ductile alpha being indicated.

The proper temperature for reheating this class of material is 625 to 650 degrees Cent. It is necessary to hold the metal at this temperature only until it is heated uniformly throughout. Fig. 22 shows the microstructure resulting from this treatment; a fine-grained alpha-delta structure. Fig. 23 shows the structure obtained in the center of a large casting by this treatment. The grain is a little coarser and the physical properties somewhat poorer.

As regards forging, it should be sufficient to say that all of the aluminum bronzes are greatly improved by this treatment.

For the benefit of those who are not familiar with them several miscellaneous photomicrographs are included. Figs. 24, 25 and 26 are all of a 10 per cent aluminum bronze chill-cast, die-cast and forged, respectively. They should be compared with Fig. 10 which also is a micrograph of a bronze with 10 per cent aluminum. Fig. 27 shows the twinned crystals of a 7-per cent aluminum bronze after forging. Compare this with the structure which is shown in Fig. 4.

## Book Review

*Metallurgy of the Common Metals* by Leonard S. Austin; 615 pages, 5¾ x 8¾ inches; cloth; published by John Wiley & Sons, Inc., New York, and for sale by THE FOUNDRY, Cleveland, $7 postpaid.

Eight years having elapsed since the appearance of the fourth edition of this volume, which first was published in 1907, the author, who formerly was professor of metallurgy and ore dressing in the Michigan School of Mines has rewritten the book in its revised and enlarged form. He points out that such radical changes and improvements have been made in the metallurgy of the common metals that it has been necessary to rewrite the book in order to bring it into accord with modern practice.

In its new form the book continues to discuss gold, silver, iron and steel, copper, lead and zinc. The book is divided into nine parts which are subdivided into a total of 50 chapters. Part I is devoted to general metallurgy, discussed in 10 chapters; Part II covers gold, in nine chapters; Part III, silver, five chapters; Part IV, iron and steel, two chapters; Part V, copper, eight chapters; Part VI, lead, five chapters; Part VII, zinc, four chapters; Part VIII, plant and equipment and their costs, four chapters; and Part IX, the business of metallurgy, three chapters.

Part IV, devoted to iron and steel, embraces iron ores and their smelting, in one chapter, and wrought iron and steel in the other. The first chapter is subdivided into 21 parts and the second into 15.

The book is profusely illustrated with 328 half tone and zinc reproductions and numerous tables and formulas, is well written and is so arranged as to form a handy volume not for class room purposes only but for reference in actual metallurgical practice.

## Safety Glasses Strongly Recommended by Report

Accidents to the eyes are charged with 10.6 per cent of the permanently disabling causes in industry according to a report issued recently by the committee on elimination of waste in industry of the American Engineering council. The report, which embodies the results of an investigation in connection with the assay of waste in basic industries started by Herbert Hoover, gives the total number of industrial blind in the United States as 15,000, or 13.5 per cent of the total blind population.

Present protective methods, as applied in large plants, are shown to have effected a great reduction in these injuries. In the plants of the American Car & Foundry Co. a reduction of more than 75 per cent has been effected through the use of goggles as a protective device, and the management is quoted as saying that this percentage would be even higher if the men wore them more conscientiously. Experience has proved the fallacy of the theory that in the event of accident goggles further jeopardized the sight.

# Equipment Features Malleable Shop

BY H. E. DILLER

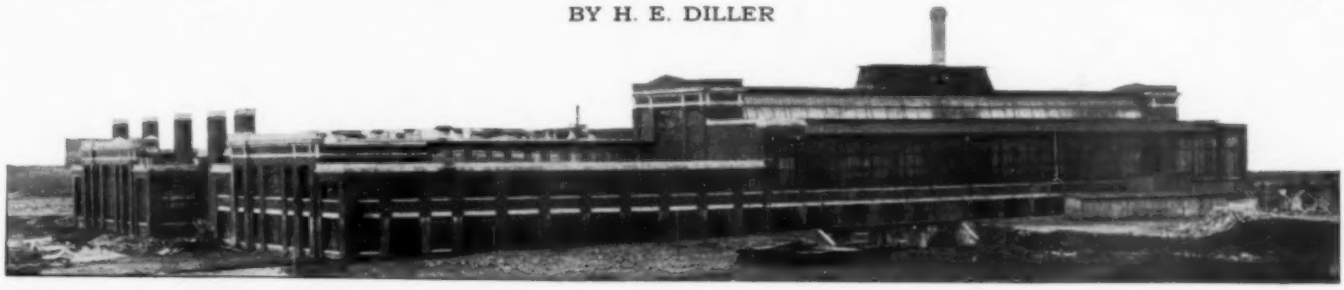


Fig. 1—Outside View of the Foundry Building—The Stacks of the Annealing Ovens Shown at the Left

ECONOMY and service, as essential to the transportation system of the country, have been strongly emphasized during the past few years by the increased freight rates and embargoes at the rush of business activity when transportation service was so necessary. Every person in the country was made to realize the importance of the railroads to the country because all classes were either directly or indirectly financially affected. However, transportation in the foundry has not been generally studied as much as its importance deserves. When it is considered that the production of 100 tons of castings requires the handling of approximately 17,000 tons of materials and equipment, as shown by Max Sklovsky in THE FOUNDRY of April 15, the magnitude of the handling problem in the foundry may be realized.

Therefore in designing a foundry the kind of furnaces and the equipment to be used do not constitute the only major problem, but the means for conveying the sand, melting stock, castings and sprue forms probably an even more complex question to be solved. The new foundry of the American Chain Co., New York, located on the outskirts of York, Pa., is an exemplification of handling methods, although other details have not been neglected in the effort to perfect the handling system. On the contrary the same degree of thought has been given to the melting furnaces and annealing ovens and to the general layout of the plant by the designing engineer, E. H. Sacket, consulting engineer, York. Mr. Sacket was assisted in solving many of the problems which came up in the design of the foundry by A. T. Willis who came to the American Chain Co. about two years ago to act as foundry superintendent, having formerly been superintendent of the malleable iron foundry of the General Electric Co., Erie, Pa.

Radical departures from general practice have been made in all three stages of conveying, melting and annealing. Pig iron and scrap are brought to the melting furnace by a telpher crane and the castings are handled through the molding department to the hard-iron room, the annealing department, and the soft iron

FIG. 2—THE TWO MELTING FURNACES ARE LOCATED IN THE CENTER OF THE MOLDING DEPARTMENT—CASTINGS ARE CARRIED TO THE CLEANING ROOM ON A TROLLEY SYSTEM WHILE THE SPRUE IS DROPPED DOWN CHUTES TO THE LOWER FLOOR

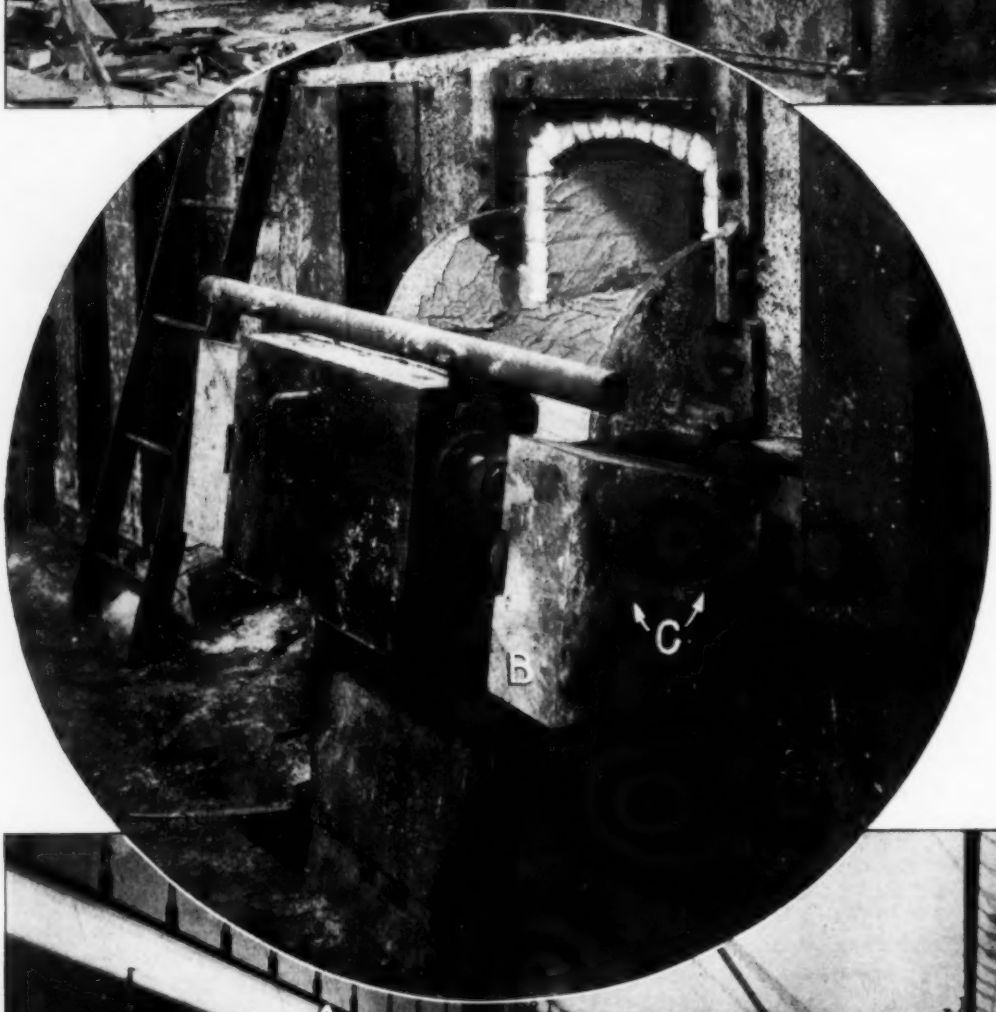
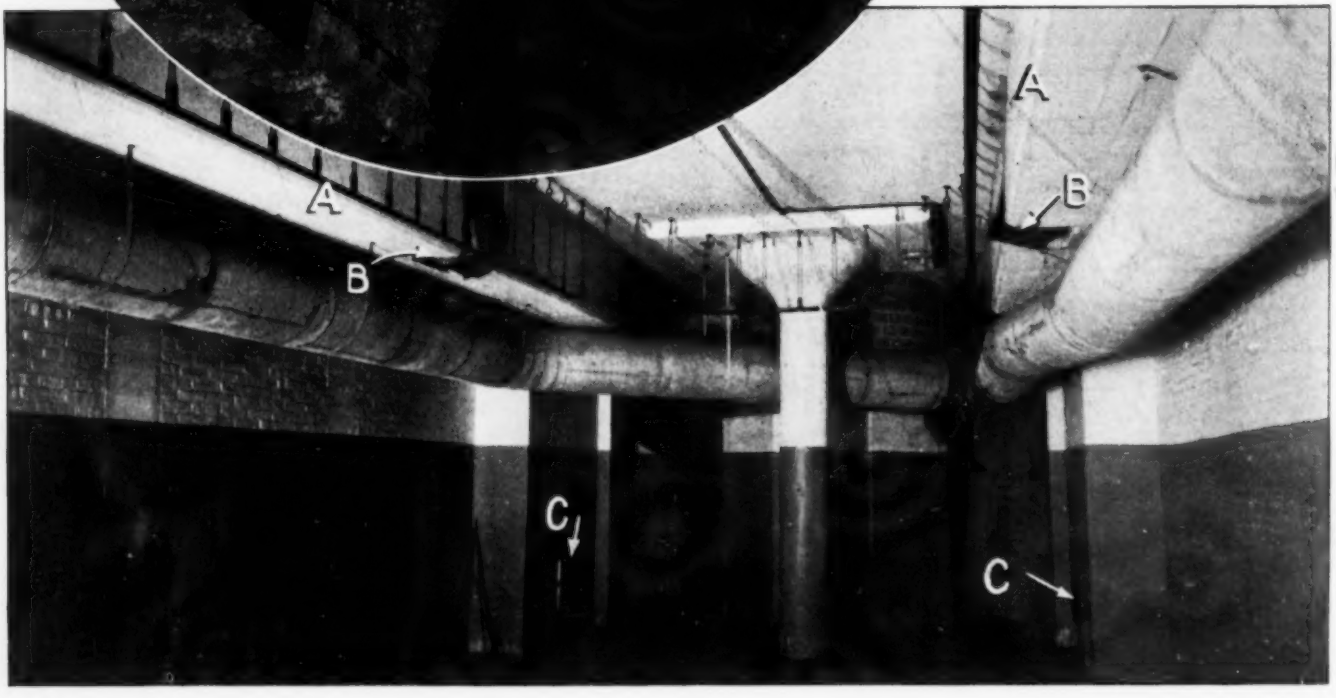



FIG. 3—COAL IS FED TO THE FURNACE THROUGH THE SMALL PIPES SHOWN AT THE END OF THE FURNACE WHILE AUXILIARY AIR IS SUPPLIED THROUGH THE LARGER PIPES COMING FROM THE FLOOR FIG. 4—SLAG WHICH IS SKIMMED OFF THE METAL DROPS THROUGH A CHUTE INTO A BUCKET FIG. 5—ROOM UNDERNEATH THE FURNACES SHOWING THE ENDS OF THE SLAG CHUTES AT *BB*



cleaning and sorting room by a light overhead trolley in conjunction with chutes and conveyors designed to secure the maximum of economy in handling. Slag is skimmed from the melting furnace so that it drops into a chute and is carried out of the way of the furnace tenders. In the annealing department a semiautomatic device for packing the castings has been installed. The most radical step is the plan for charging and discharging cars packed with pots of castings into and out of the annealing ovens. All the melting and annealing furnaces are heated with powdered coal, as are also the boilers.

To understand the handling system the layout of the plant should be understood. When completed the plant will consist of one main building two stories high in the shape of a U, and one smaller building located near the opening of the *U*. The smaller building will be used for pulverizing the coal. All foundry work will be performed in the larger building. The two branches of the *U* will be molding and melting departments. At present only one of these legs is built. The other one will be erected when the foundry has been operating for a short time. Between these two molding departments the stock yard is located, and the building at the end, joining the two molding departments is used for cleaning and annealing. It also contains the offices, core room and laboratory, as well as a kitchenette and lunch room and locker rooms for men and for women.

Pig iron and sand are received at the opening of the U. The sand is dumped from the railroad car into a hopper through a grating. From the hopper it is delivered to a 14-inch belt conveyor which drops it on a cross belt to be carried to the different bins on the lower floor. It can be scraped from the conveyor to the desired bin by a slide scoop. The belt is cleaned by a revolving brush as it passes over the wheel at the end of the conveyor. The conveyor system was furnished by the Webster Mfg. Co., Tiffin, O. The bins are formed by sliding boards into channel beams 5 feet apart.

All sand is not delivered to the main storage bins but when possible sand is delivered directly from the cars to either of two 25-ton capacity daily storage bins at each end of the molding floor. In this case the sand drops into the hopper under the railroad track and is carried by the belt conveyor which delivers it to either one of two pan conveyors by which it is elevated to one of the daily storage bins. These bins each have five chutes on the side and the sand is run through any one of the chutes to a bucket on a conveyor, by raising a gate. These light conveyors which run all through the foundry were furnished by the Louden Machine Co., Fairfield, Iowa. Sand can thus be delivered to any floor. To get sand from the main storage a portable conveyor designed by the Chain company is used to deliver it to one of the pan conveyors already noted.

The pig iron is unloaded from the railroad cars with a magnet carried by a crane having an 80-foot span. This crane which is of unusual design for this class of work was furnished by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. The feature of the crane is that it carries a telpher in which the operator is stationed. In making up the heat pig iron is dropped into buckets with a magnet and carried to a platform which extends between the two molding sections. Here it is weighed. Pig iron of different composition is kept in separate buckets so that the weight of the charge can be changed after the charge has been weighed if it is ever found desirable to do this. To charge the furnace the telpher picks up two buckets having a capacity of 5 tons each and carries them into the foundry through a vestibule and over the furnace to be dumped. Fig. 6 shows the telpher entering the foundry without any load. To the left may be noted the vestibule with the inside doors open. Doors are on both ends of this vestibule. As it enters, the telpher opens the outside doors with the curved rail, or radius bar, shown at A. The doors are held open until the telpher is through by this bar which extends along the entire length of both sides and around the other end. When the telpher gets in the vestibule the

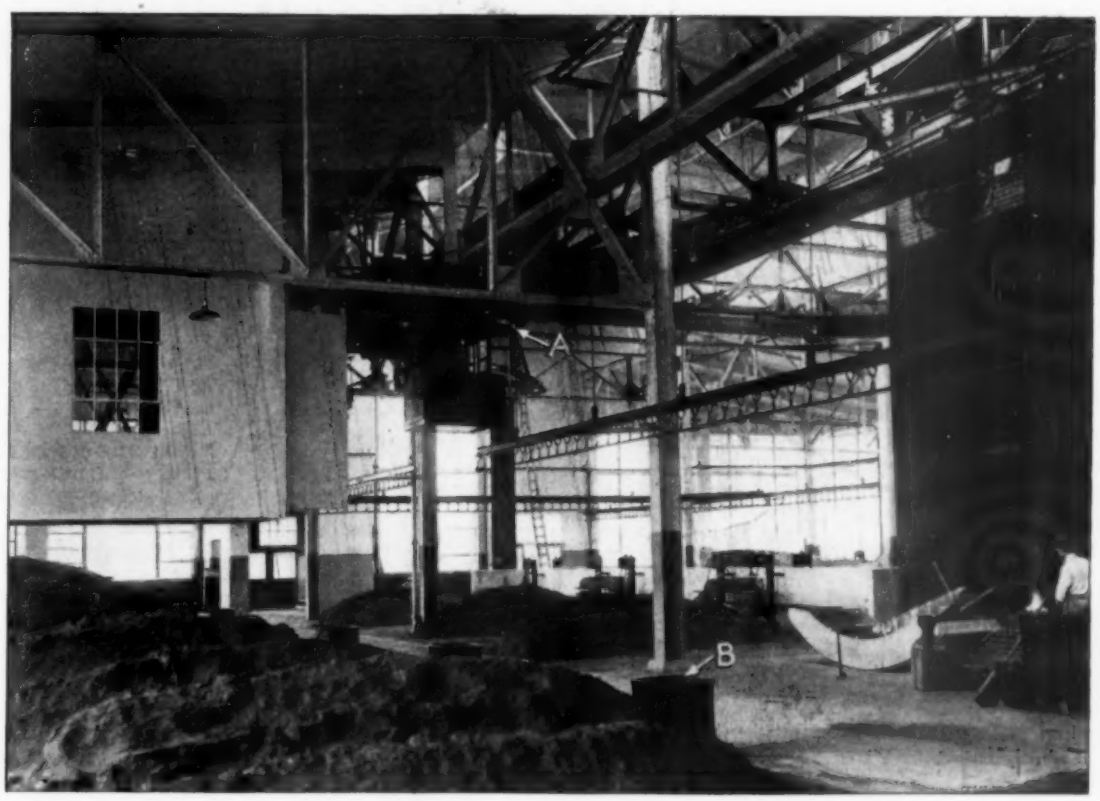
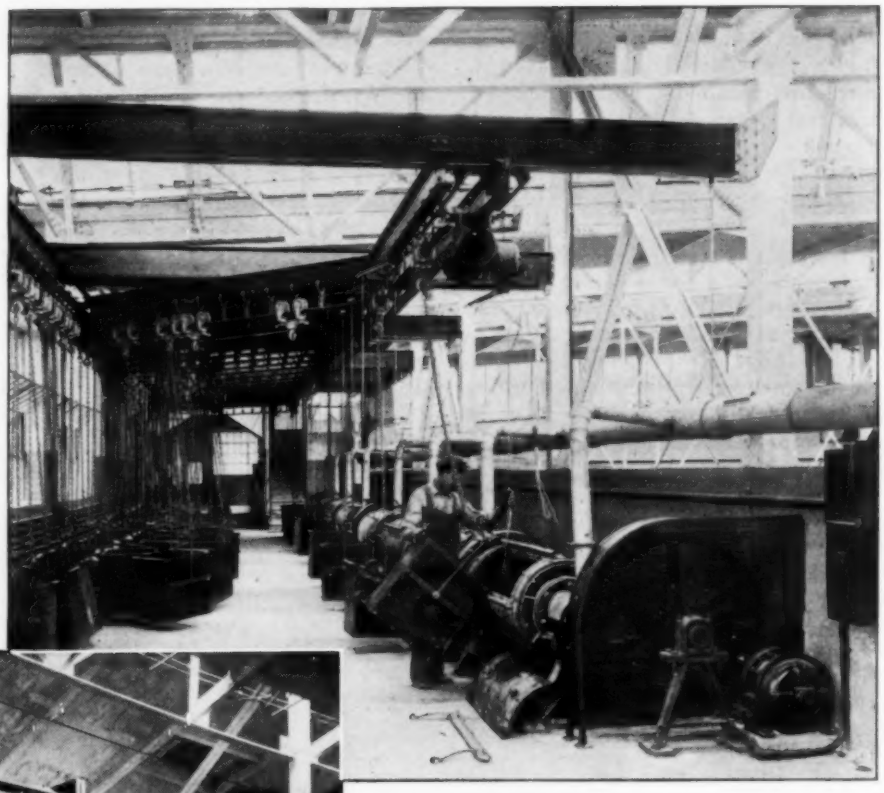


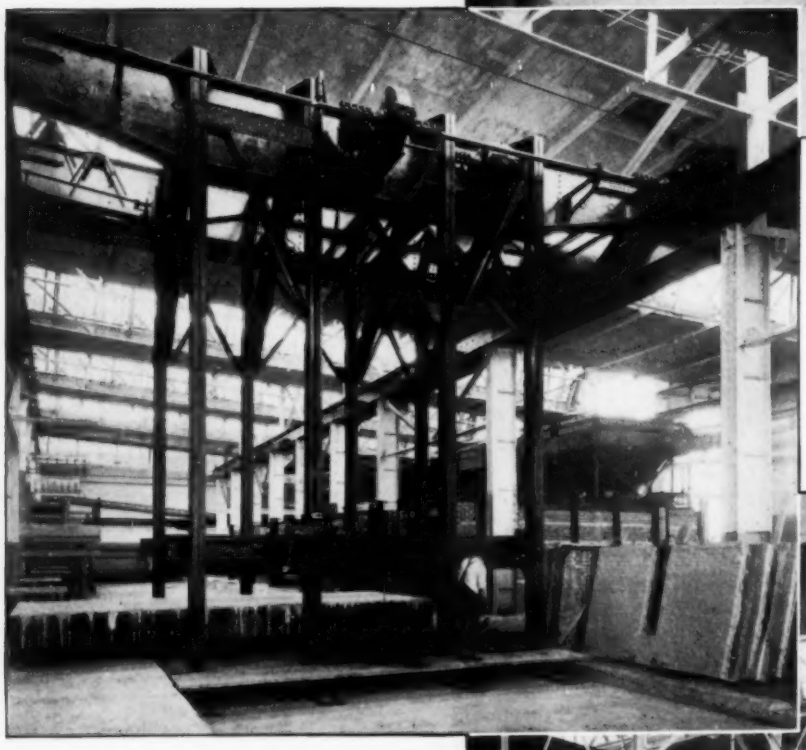

FIG. 6—THE TELPHER CRANE WHICH BRINGS IN THE STOCK ENTERS THROUGH THE VESTIBULE SHOWN AT THE LEFT

doors automatically close and as it moves on the inside doors open and close in the same manner as the outside ones did. This prevents drafts from blowing on the molders and will be especially beneficial in the winter.

The telpher runs on a system of tracks by means of which it can come over either of the two furnaces to dump its charge, or can come in front of either furnace to receive a ladle of iron. This system of tracks is equipped with switches electrically controlled by the telpher operator. A while-light and a red-light signal are at every switch to designate whether it is open or closed. A portion of the track is clearly indicated in Fig. 2 which shows the two 20-ton melting furnaces located near the center of the molding floor. The white tower around which the track curves is a shaft for the elevator which is installed to carry material or passengers from the lower floor to the molding department. Aside of it is the storage hopper for the powdered coal to be used in the melting furnaces. Below the hopper is the control room for the powdered coal, equipped with electric controllers for regulating the screw feed and air. A relay is provided for each furnace so that one of the two burners can be shut off and the speed of the fan cut down.

The burner can be plainly seen in Fig. 3, which gives a close-up view of one of the two melting furnaces, from the side which faces the other furnace. As may be noted two tapping spouts and two skimming doors are located on





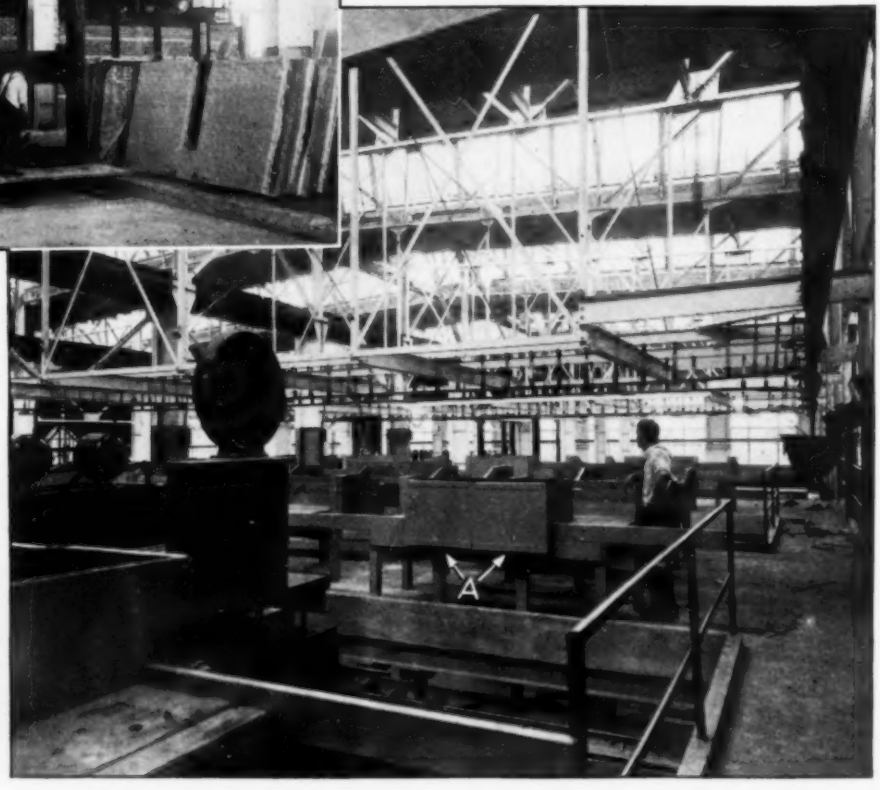



FIG. 7—AT THE RIGHT—CARS ARE HANDLED IN AND OUT OF THE ANNEALING OVENS BY A BASKET CRANE FIG. 8—ABOVE—CASTINGS ARE BROUGHT TO THE HARD-IRON TUMBLING ROOM IN STEEL BOXES FIG. 9—BELOW—CHIPPING AND GRINDING DEPARTMENT

this side of the furnace. On the opposite side are two tapping spouts. Another door may be seen on the side near the burners. This door is used to clean out the firebox in front of the burners.

Coal is fed to the burners through galvanized-iron pipe, portions of which may be noted at *A*, Fig. 3. It is propelled by screw feed and a small amount of compressed air is used to prevent it clogging in the pipes. The main air supply is brought through the large pipes extending vertically from the floor. These burners were supplied by the Fuller Engineering Co., Allentown, Pa., who furnished all the powdered coal equipment.

The bungs are 31 inches wide and built with the brick which, or what is called broken joints. In this way as many as 8 or 10 brick could fall out of a bung in different places and the bung would still hold up. The holes left by the fallen brick could be stopped with clay until the end of a heat, thus avoiding the necessity of replacing a bung during a heat. Three of the clamps shown at *B*, Fig. 3 are used on each end of the bung. Thus three bungs are shown in place in that end of the furnace, as is also indicated by the three looped rods projecting above the furnace and used to lift the bungs with the telpher.

Regulation of the heat in the furnace cannot only be controlled by cutting off one burner, as has been noted, but a damper is provided for this purpose over the bridge wall nearest to the stack. At the bridge wall the side walls are contracted so that the opening at this point is only about two-thirds the width of the inside of the furnace. The damper which is made of a three-sided angle-iron frame filled with firebrick is held by counterweighed chains extending over pulley wheels on a steel girder as is shown over the furnace to the left in Fig. 3. With this damper the draft can be controlled during the heat and the height of the port over the bridge wall can be regulated as the bridge wall builds up or is cut down in time by the flame.

A waste-heat boiler furnished by Babcock & Wilcox, New York, is located at the end of each furnace. These boilers are three high, so it was expected the draft in the stack would not be strong enough and a fan has been provided above each. The hot gases pass from the furnace to the under portion of the boiler, then up through the boiler and are forced by the fan into the stack which is connected to the boiler by a steel-plate housing. The boilers are entirely covered with soot blowers supplied by the Diamond Power Specialty Co., Detroit. They are also equipped so they can be heated with powdered coal when the furnaces are not being fired. One of the boilers is shown to the extreme right in Fig. 6, while another view of the boilers may be seen behind the stack to the right in Fig. 2.

The melting furnaces are not built on a solid foundation but on rows of piers extending from the ground up through the floor below. An idea of the foundation can be obtained from Fig. 5 which shows the space directly under the floor between the two furnaces. Two of the piers supporting the furnaces may be noted in the brick wall to the left. Beyond each wall are two more rows of piers. The angular extensions from the wall on both sides, *A*, *A*, are a portion of an 8-inch reinforced concrete slab set on the piers. Over this is a covering of sand 4 inches deep on which the cross ties and buckstaves for the furnace are held by a 4-inch layer of concrete. The brick work of the furnace is built on these cross ties and between the buckstaves. The furnace does not touch the floor of the molding department, the space being filled with loose cinders. In this way the furnace is entirely independent of the floor and is a unit by itself free to expand or to contract when it is heated or cooled.

The two chutes, *B*, *B*, Fig. 5 are a part of a novel development, the upper portion of which is shown clearly in Fig. 4. This may be recognized as one of the skimming doors previously referred to. The door is swung on a pinion *O*, and is counterweighed by the weight *B* which is adjusted on the bolts, *C*. When open, as shown in the illustration, the heated side of the door is away from the furnaceman and does not radiate heat directly against him, as would be the case if the door swung sideways on a hinge. The pipe on top of the door serves to support the skimming bar. When the slag comes from the furnace it falls down the chute shown underneath the door and does not form a heated mass on the floor

FIG. 10—THE LABORATORY IS COMPLETELY EQUIPPED—NOTE THE PHYSICAL TESTING MACHINE TO THE RIGHT

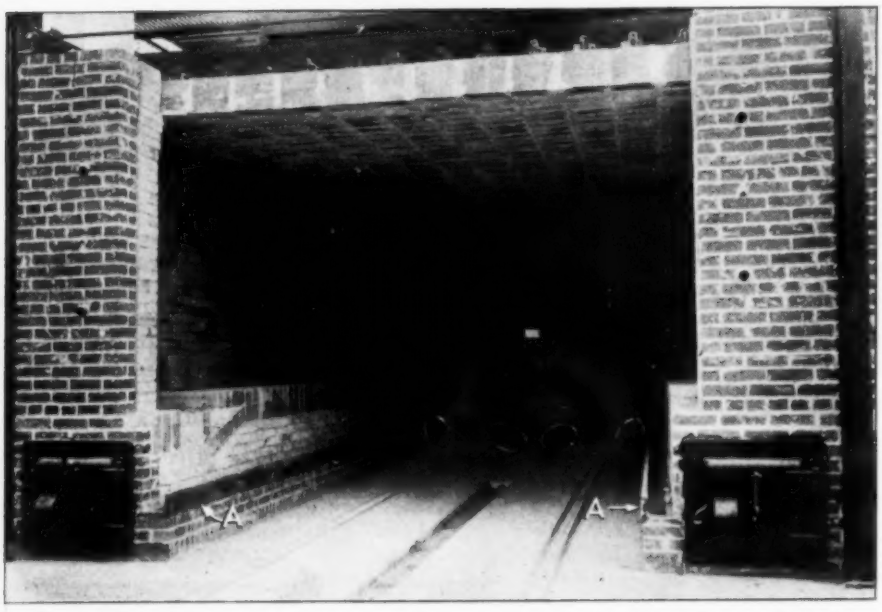


FIG. 11—INTERIOR OF ONE OF THE CAR-TYPE ANNEALING OVENS

around the furnace. It drops through the spout into a perforated slag bucket 4 feet wide, 6 feet long and 14 inches deep, carried on the overhead track illustrated in Fig. 5. The method of handling it from this point will be explained later. Water is sprayed against the slag to disintegrate it. The steam generated is drawn from the room by suction and the water which falls on the floor runs out a drain.

A pocket just beyond the rear bridge wall of each furnace acts as a dust collector and is cleaned through the two doors shown at *C, C,* Fig. 5. The clean-cut door for the stack may be noted beyond the post in the same illustration.

*Foundry Designed For Light Castings*

From the furnaces the iron can be carried to the molding floors either in hand ladles, in ladles up to 2 tons capacity on the Louden conveyor, or in 5-ton ladles by the telpher. At present it is anticipated that all the work, in this section, except the annealing pots, will be extremely light. When the other section of the foundry is built heavier castings will be made there and the pots will also be cast in that department from cupola iron. The present melting and molding department which is 120 by 256 feet is equipped entirely with squeezer machines furnished by the Federal Malleable Co., West Allis, Wis. A total of 80 machines have been installed, arranged on both sides of the two aisles which extend the length of the foundry. On each row along the walls are 29 machines. The center of the foundry between the two gangways is partly taken up by the furnaces with their equipment and the sand hoppers for daily storage so that the two center rows of molding machines which face each other have one section containing six machines in each row and another with five in each row.

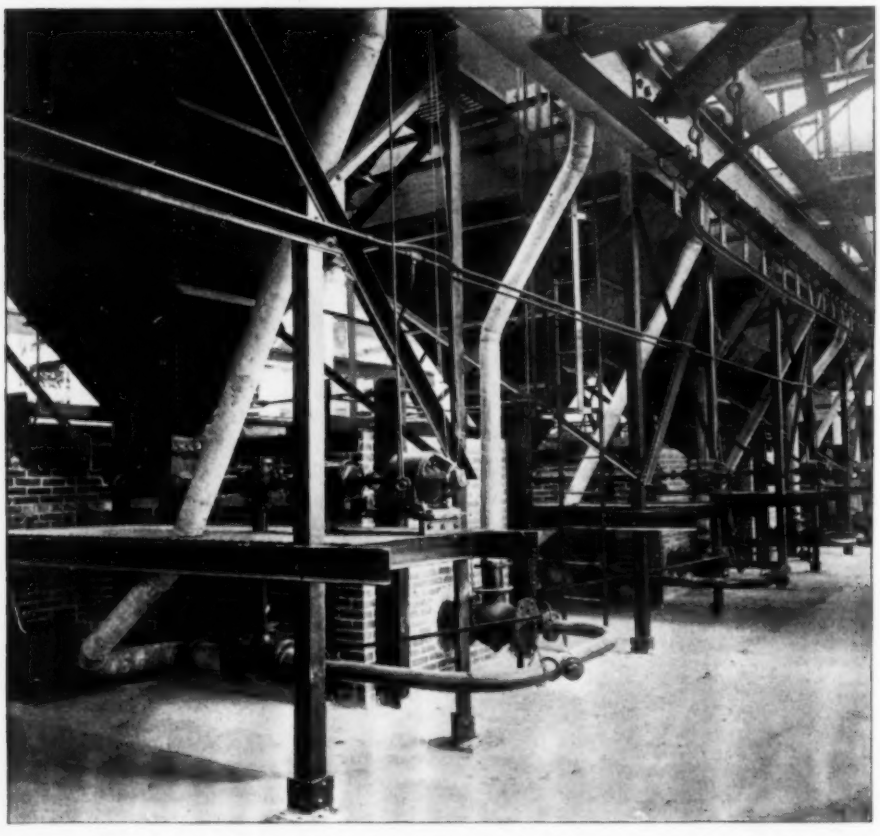


FIG. 12—THE COAL FEED FOR THE ANNEALING OVENS IS SIMILAR TO THAT FOR THE MELTING FURNACES, FEEDING COAL THROUGH THE SMALLER PIPES AND AUXILIARY AIR THROUGH THE LARGER ONES

Castings after they are poured and shaken out are laid near the aisles which are paved with brick, the molding floors being sand. The sprue is then broken off and thrown into one of the chutes which are placed along the gangway at the end of each floor. A few of these chutes, one of which is marked *B,* may be noted in Fig. 6. Each chute leads to a hopper large enough to contain six days' accumulation of sprue from one floor. When sprue is needed it is dropped through a gate on any of the hoppers into a bucket and carried to the stock yard on the overhead track. Here it is picked up by the telpher and carried to the scales to be weighed.

In addition to the chutes for the sprue along the gangways, gratings are provided in the aisles so that sweepings can be dropped into them instead of being swept back on the floors. The sweepings fall into hoppers and are carried in buckets on the overhead trolley system to the magnetic separator. Two water connections with concrete reservoirs are also located along each gangway.

*Castings Transferred on Trolley System*

Castings are thrown into buckets, each of which has a capacity of from 1200 to 1500 pounds of castings. The buckets are then carried by the trolley system into the hard-iron tumbling gallery immediately adjacent to the molding department. Here they can be stored on a system of many parallel tracks shown in Fig. 8. A network of switches is installed for transferring the buckets on the storage tracks. All switches on overhead trolley system are controlled by hand operated chains. Also an

automatic safety device is provided in the form of a pronged fork which drops down when the switch is open and raises when the switch is closed. The hard-iron cleaning gallery is equipped with eight tumbling mills supplied by the W. W. Sly Co., Cleveland. A 1000-pound electric hoist traveling on an I-beam over the tumbling barrels serves to remove the cover from the barrels and dump the castings in the manner illustrated in Fig. 8. After the castings are tumbled the cover is removed and the mill turned so the castings fall into a chute at the rear. These chutes lead into the chipping department where the castings are dropped into a bucket carried by a trolley. Fig. 9 shows at the right a bucket under one of the chutes which is open to deliver castings. The chute aside of it may be seen with the apron gate at the end of it closed to prevent casting falling on the floor if dumped in the chute while a bucket is not under it. The bucket carries the castings to one of the 28 chipping and grinding benches.

### *Castings Held in Hoppers*

Each bench eventually will be equipped with a small grinding wheel and a sheet-steel hopper, two of the latter being shown at *A*, Fig. 9. When a casting is chipped and ground it is thrown into the hopper on the bench at which the chipper is working. These hoppers are arranged on two sides of a submerged track on which a car is operated. This car is equipped with a hopper for holding packing grit and another for castings, besides a scale. The scale car travels over another track on which an annealing car filled with pots is set. The pots are loaded with castings by allowing the grit and castings to run from the hoppers on the scale car. Valves are provided on both hoppers and the operator is in such a position that he can see the flow of castings and grit and regulate them with the valves so that they pack solid.

When all the pots on a car are filled and luted the car is pulled onto a 100-ton basket-type transfer crane and carried to the track in front of the oven to be charged. This crane which travels the full length of the annealing room was built by the Shepard Electric Crane & Hoist Co. The cars are pulled on and off by means of a sliding rack and pinion on the crane.

At present the annealing department is equipped with six ovens and space has been left for installing four more ovens, two of which will hold two instead of one car as is the capacity of the present ovens. Fig. 11 gives a view of the inside of one of the ovens. The car is pushed in on the two tracks shown, by the rack and pinion attached to the basket crane. The groove in the center of the oven has been made to allow the rack which is below the car to enter the oven. Gases from the oven will be prevented from penetrating underneath by the two sand seals on the sides of the oven, shown at *A*, *A*, Fig. 11, and by sealing the door. One of the doors may be seen to the right in Fig. 7. It is lifted by the crane which is attached to the loops on the top of each door and set in the oven, the angles on each side fitting in grooves between the firebrick and the outside brick, which is then filled with sand. The bottom of the door rests on a sand seal on the car. The slot in the middle of the door is filled with brick which is taken out when the heat is cooling to quicken the process. Also by the system installed the car can be withdrawn before entirely cool and another car charged, thus conserving the residual heat in the walls and roof of the furnace.

It has been deemed essential to provide means to prevent the truck of the car becoming too hot. This is accomplished by placing four ventilating ducts in the rear of the oven as may be noted in Fig. 11. In a trial heat the temperature under the car did not get above 348 degrees Fahr. while the oven registered 1650 degrees. The iron doors shown on each side of the oven are for cleaning the flues. Above these may be noted two holes which are for the thermocouples of pyrometers. A similar set of holes are located in the rear of the oven. Thus temperature readings can be recorded on both sides at rear and front and the heat can be regulated in these four sections by dampers controlling flues which divide the oven into four heating zones. Then if one corner becomes too hot or too cold it can be regulated by adjusting the damper in the flue serving that section of the oven.

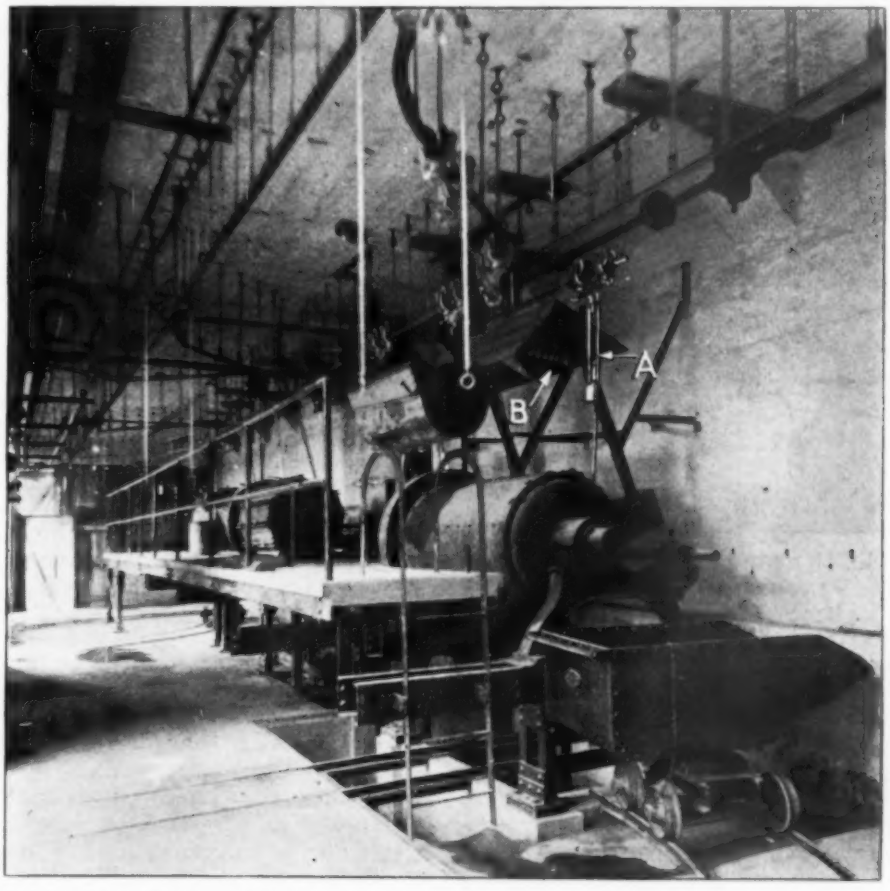



FIG. 13—MATERIAL IS BROUGHT TO THE WATER MILL AND DUMPED THROUGH THE FUNNEL *B* WHICH SWINGS ON COUNTER-WEIGHTED ARMS

The twelve double-recording pyrometer instruments supplied by the Brown Instrument Co., Philadelphia, are installed in a room behind the ovens and the regulating device for each oven, similar to that provided for the melting furnaces, is stationed directly under the pyrometers which serve the oven. The coal feed which is similar to that of the melting furnaces is located directly behind each oven as indicated in Fig. 12.

When the car is pulled from the oven it is taken to the unloading track

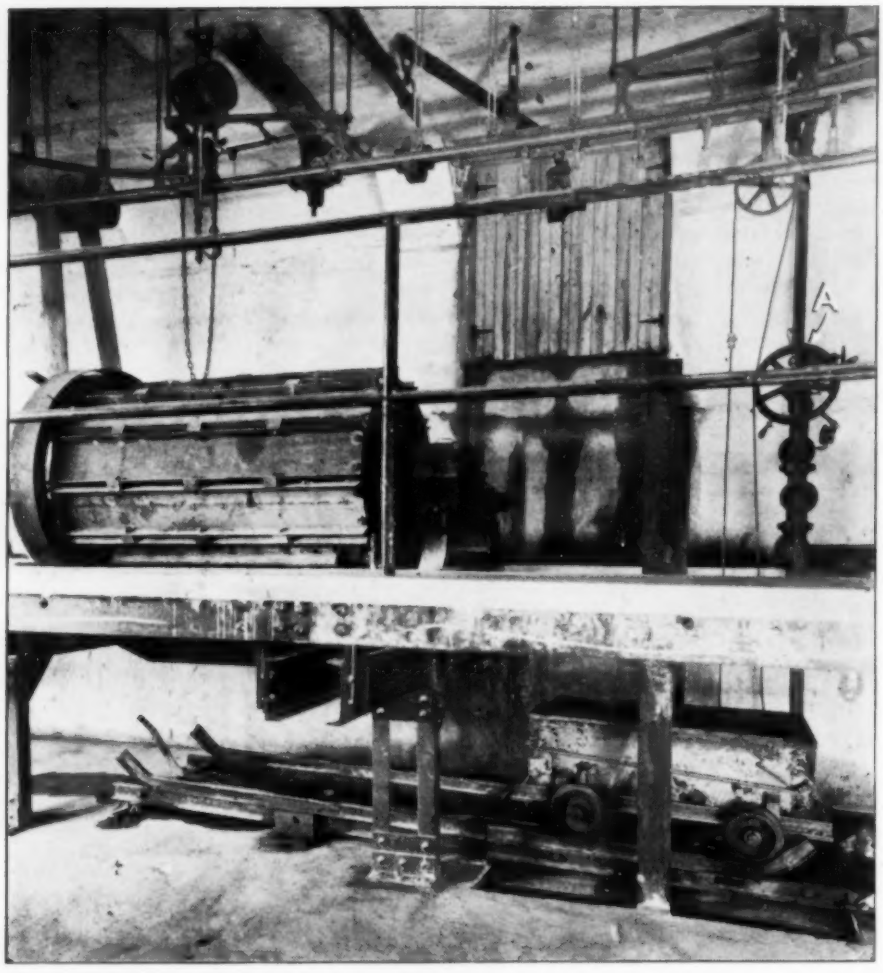


FIG. 14—THE CAR UNDER THE CINDER MILL IS CARRIED ON A TILTING TRACK TO THE ELEVATOR IT IS SHOWN RESTING ON

by the basket crane. Here the pots are emptied into a separator which takes out the grit and dumps it into boxes on the trolley system. The castings also are dumped into a box on the trolley system and when the box is filled the trolley is released and runs by gravity to an endless-chain conveyor which elevates it to the soft-iron tumbling and sorting gallery. Reaching this gallery the trolley automatically leaves the conveyor and travels on an inclined track to a set of storage tracks similar to the ones shown in the hard-iron gallery.

*Castings Dropped Through Pipes*

Two tumbling barrels and two sand-blast barrels, one of the tilting type, furnished by the W. W. Sly Mfg. Co., are located on the soft-iron gallery. After the castings are tumbled or sandblasted they are distributed to the sorting benches by means of the trolley system. These benches are each provided with eight pipes leading to hoppers in the shipping department. The pipes are 4, 6 and 8 inches in diameter and the number of each size is varied on the different benches. Castings of a single pattern number are thrown into each pipe. This is made possible because in the molding room castings from a single floor or from a section are thrown into one box. This box is large enough to hold a charge for a tumbling barrel and the castings from each tumbling mill are kept separate in the hard-iron cleaning room by the method already described. Then the castings are loaded in the anneal and taken out and delivered to the cleaning room in such a manner as to keep the castings from one section of the foundry together. In this way it is thought that castings of not more than eight patterns will ever get to any sorting table in the soft-iron gallery.

Having eight pipes from each of the 28 benches in the soft-iron sorting gallery, the shipping room eventually will be equipped with 224 bins or hoppers for storing castings. The hoppers at present installed are located high enough off the ground so that a shipping container can be placed under any one of them and the desired castings allowed to flow into the container by opening a gate. The container is then trucked to the scales and after being weighed is transferred directly to the railroad car on the siding which is long enough to hold four cars at once.

The core room, located on the lower floor, is comparatively small as it is estimated that five coremakers will make all the cores normally required for the present molding department. Sand is brought to the mixer in buckets on the trolley system. An overhead track also extends in front of the row of coremakers' benches so that sand can be dumped into hoppers on the benches. Cores are placed on plates on racks directly behind the coremakers and carried from there to the ovens, of which at present four of the drawer-type furnished by the W. W. Sly Co., are installed. As the cores will be exceedingly small it is easy to distribute them to the molders on wheelbarrows built for this purpose with special springs, carrying them to the molding floor on the elevator.

*Automatic Control of Car*

The refuse reclaiming room is interesting for the novel equipment installed. As has been pointed out, the slag is brought to the water mill on a trolley after having been disintegrated with water. A view of this mill is shown in Fig. 13. However, the bucket shown hanging on the trolley is not the type which is used for slag although it serves to illustrate the operation of the charging equipment. When slag is received the cover of the water mill is removed with the lifting lever carried on the overhead track and shown at *A*, Fig. 13. On account of the leverage one man can easily do this although the cover weighs more than 100 pounds. The funnel, marked *B*, which swings on counterweighted arms is then lowered and the slag dumped through it. The washed dirt then flows into the bucket shown aside of the mill and the metal is dumped directly into a charging bucket placed underneath on a small car. The tracks slope so that when the car carrying the bucket is released it runs out into the stock yard and can be carried by the crane to the weighing platform.

Aside of the water mill may be seen, in Fig. 13, a tumbling mill for grinding firebrick to obtain brick dust and vitrified slag to reclaim any metal in it. This was made of 10-inch channels by the Chain company. The novel feature in connection with this mill is the method of getting away the material after it is crushed. The brick or slag to be crushed is carried to the mill by an overhead trolley and pumped by means of the chain hoist shown in Fig. 14. The car shown under the platform illus-

trates the method of dumping the material. The operator by means of the wheel shown at *A*, Fig. 14, lowers the hydraulic elevator and at a certain height the track on the elevator tilts towards the track under the barrel which slopes in the same direction. This causes the car to run under the barrel. When the car is filled the elevator is lowered to the lowest point by the operator on the platform. This causes the two tracks to tilt so that the car runs onto the elevator. The car is shown at this stage. The elevator is then raised to the platform and the car is carried to the magnetic separator furnished by the Dings Magnetic Separator Co., Milwaukee, at the end of the platform where iron is separated from the crushed slag.

*Heat with Powdered Coal*

Powdered coal is used for all heating purposes and a complete pulverizing plant has been built. As has been stated this is in a separate building located at some distance from the foundry building. Coal is dumped off the railroad cars into a concrete storage bin having a capacity of 7500 tons of coal. It is brought from storage to a crusher by a pan conveyor and after being crushed is elevated to a bin over the dryer by another pan conveyor. It is fed through the dryer which is set in a sloping position by shaker feed. A dust collector at the end of the dryer gathers all dust which is carried to the pulverized coal bin. The coal which passes through the dryer is elevated to a bin over the pulverizing mill by a pan conveyor. At the bottom of the pulverizing mill the coal passes over an 80-mesh sieve and is pumped to the storage bin.

Coal is pumped from the main storage bin to hoppers in different parts of the foundry, each unit in which powdered coal is used having its individual storage bin. These units are the two melting furnaces, the six annealing ovens, the steam boilers, and the coal drier. An automatic device prevents coal being pumped to more than one station at a time. If an operator wants coal in a certain bin he telephones to the powdered-coal plant and opens the switch leading to that particular bin. If any other switch on the system is open the operator at the station cannot begin to pump, nor can he pump if the switch to the bin for which coal has been requested is not open. The coal is pumped by means of a screw feed in conjunction with compressed air. Scales are provided so the coal in the storage hopper can be weighed before pumping is started and again after the daily storage bin has been filled. In this way it is possible to keep a record of the amount of coal used at each station.

A complete power station is equipped on the first floor of the main building. This contains the fans for furnishing air to the powdered-coal system, boiler feed pumps, and both low and high-pressure turbines to propel the generators. A well has been dug to secure water for industrial purposes and the drinking water, which is obtained from the city, is pumped through a coil in the well to cool it. The foundry is heated by air forced through coils of steam to all parts in pipes. Ventilation is secured in the molding department by means of the large monitor shown in Fig. 1. This latticed monitor is built entirely of copper and the ventilation is regulated by traps which can be closed to prevent any ventilation through the monitor, or can be completely opened to afford full ventilation.

Raw materials and the product of this foundry as well as of other plants of the Chain company are analyzed and tested in a completely equipped laboratory shown in Fig. 10. To the right may be seen the 100,000-pound testing machine and the equipment for carbon combustion determination. The main work bench is in the center of the room and the hood may be seen against the wall to the left.

*Dry with Hot Air*

As has been said, locker and wash rooms are provided. These have a constant circulation of air, either cold or hot. During the day the air is kept at normal temperature but at night the temperature is raised for drying clothes which the workmen hang up. Individual wash bowls and showers are provided for the men. The girls' wash room is similar to that provided for the men except that it is much smaller and no showers have been installed. A rest room also is provided for the women. The facilities for the women are so much smaller than those for the men because few women are employed, the need for hiring men, wherever possible, being accentuated by the complete mechanical handling system which reduces the amount of unskilled labor necessary to a marked degree.

As the plant is a short ways out of the town few will go home for lunch but a complete kitchenette and lunch room has been provided, no distinction being made in the service to office employes and factory hands.

## Movement To Standardize Foundry Vibrators

The foreign representative of an American molding machine manufacturer in a paper recently prepared for publication in a French trade journal stated that up to the present a lack of uniformity in standards exists among the different manufacturers of foundry vibrators. The extent to which this device has been adopted in recent years has emphasized the necessity of standardization and to that end the Foundry Equipment Manuacturer's association has inaugurated a movement among the various vibrator manufacturers to adopt a standard air meter for making tests on volume of air consumed. At present these vibrators made by various manufacturers possess absolutely no uniformity in design, workmanship or material and there is no standard of comparison by which to measure the amount of work accomplished or the volume of compressed air consumed. The association also proposes to standardize other items including holding-down bolt centers, area of piston, length of stroke and location and area of inlet and exhaust ports.

The following table issued by one of the vibrator manufacturers indicates the average consumption of compressed air by vibrators of various sizes in use for 15 seconds:

*Air Consumption of Vibrators*

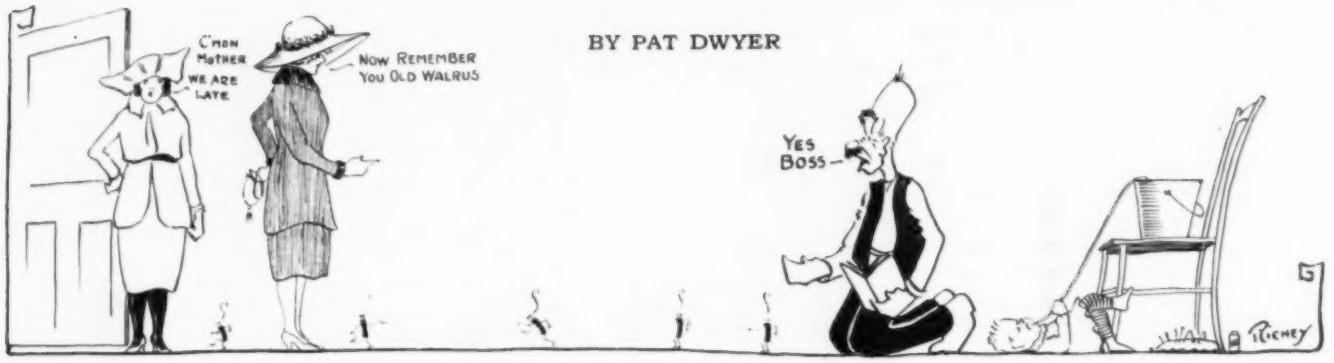
| Size | Air Used Cubic Feet |
|---|---|
| ½-inch | 0.52 |
| ⅝-inch | 0.71 |
| ¾-inch | 0.80 |
| 1-inch | 0.87 |
| 1¼-inch | 1.04 |
| 1⅝-inch | 1.20 |
| 2-inch | 1.56 |

No statistics are available on the total number of vibrators in use, but a conservative estimate would indicate that vibrators actuated by compressed air were manufactured and sold to the value of $153,000 in the United States during the year 1920. The figures for electric vibrators were not obtainable at the time the survey was made.

The average cost to the foundryman of the six most popular sizes was slightly over $10.50, but as the smaller sizes are used in the ratio of about 3 to 1, it is reasonably safe to assume that more than 20,000 new air driven vibrators were placed in operation in the foundries of the United States during the year.

# Bill Learns How Iron Pots Are Made in China

BY PAT DWYER




ONE of the movie houses in our fair city recently announced that it had arranged for one of the leading fixed, or at least pretty well fixed, stars in the firmament of screendom to appear personally, himself in person, at a limited number of performances. For a week preceding the event the newspapers carried display advertisements; a reproduction of the hero's face and the title of his starring vehicle appeared on every bill board in the city and little leaflet reminders were placed in the hands of all patrons leaving the theater. The vast army of the star's admirers and the remainder of the population who could not avoid reading the advertisements in some shape or other were advised that the coming visit was purely accidental and had been made possible through a fortuituous series of circumstances. The fact that the owners of the theater never for a moment contemplated the commercial aspect of the proposition, nor expected to reap any financial gain from the affair is evidenced from the fact that neither of these features were touched upon even remotely. I do not remember the exact wording of these various advertisements, but the impression produced on my mind was to the effect that our hero flying across the continent in his private train de luxe and finding it necessary to pass through our town on the way had decided to linger for a couple of days and give the eye-hungry populace a real treat. The manager of the theater modestly announced that he and the Star had been intimate for years and really the affair was to a considerable extent in the nature of a private visit. He had experienced some difficulty in persuading the idol to appear publicly owing to the latter's well known aversion to notoriety of any kind, but he would do his best to have him stay for the entire week and condescend to appear twice daily during that time.

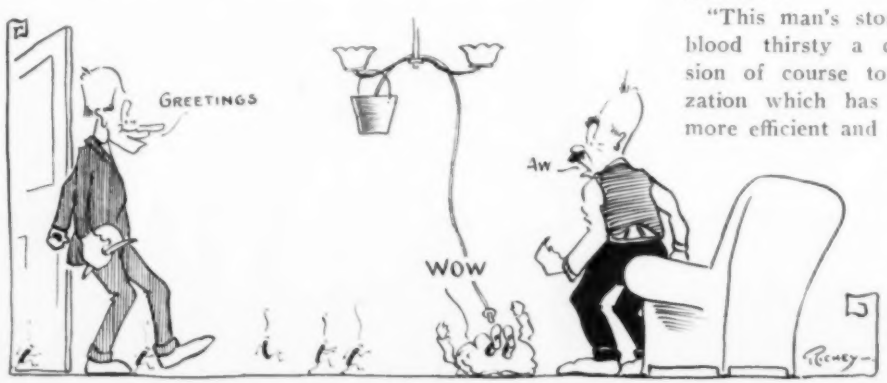
My bump of reverence for the great ones of the earth, including ephemeral movie stars has never been what you might call extensively developed and so I experienced no poignant feeling of regret nor had I any fond hopes shattered when the executive head of our little mutual co-operative association informed me that in company with her eldest daughter she intended to attend one of the performances and in consequence she relied upon me to keep diligent watch and ward over the remainder of the flock until her return. She gave me what I considered a totally unnecessary list of directions on how to handle the baby in case of emergency, either real or remote and added a caustic comment on what she was pleased to call my lazy habit of forgetting everything in the presence of a pipe and a book.

By properly directed diplomacy and the exercise of a little judicious bribery in the shape of a small coin of the realm, small to me, but representing vast possibilities in the eyes of the recipient I delegated the care of the baby to a young lady who has boarded with me since her first birthday and therefore is acquainted with the customs and habits of our household. Having arranged all the preliminaries for a quiet and peaceful evening I settled down with a pipe and a book, but had only read a chapter or two when Bill came in and stood with his back up against the mantel piece.

"Say", said he, "I met a fellow today that I had not seen for over twenty years. Away back in the palmy days of the old Walker Works in Cleveland this bird and I worked on the big grooved drums used in cable railway installations. Both of us left about the same time and although I kept track of his movements for a few years I finally lost trace of him. I have done some of that rolling stone stuff in my time, but this fellow today made me realize that I could qualify at any time as a native son and a home guard.

"He had been to the four corners of the earth and his experiences were as interesting as any of the yarns spun by that master hand at story telling, Robert Louis Stevenson. Indeed some of his references to queer and outlandish places reminded me of Long John Silver with his single leg and his parrot sitting in the fore hold of the Hispaniola telling his gang of cut throats of wild adventures on the Spanish Main, of long and perilous voyages to Surinam and Malabar and Portobello; of the last words of Captain Flint dying in the horrors in Savannah 'Bring the rum aft Darby McGraw.'

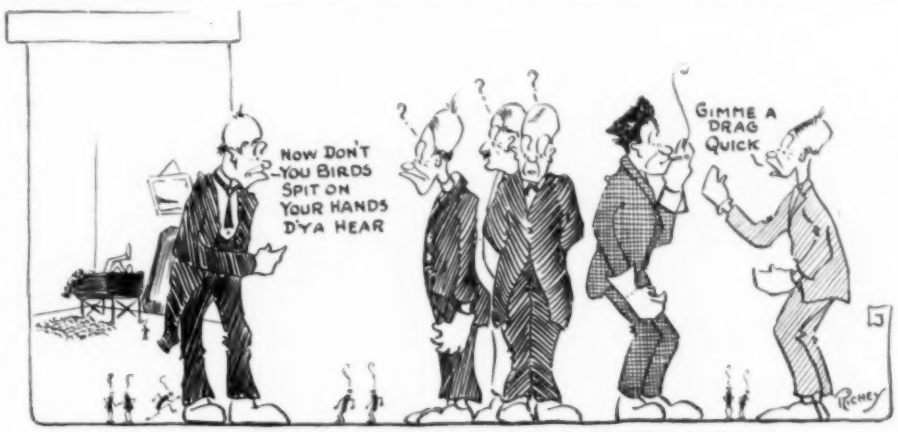
"This man's stories were not of so blood thirsty a character, a concession of course to our modern civilization which has developed so many more efficient and scientific methods of separating the investor from his savings. He dwelt principally on foundry conditions in the different countries he had visited and in illustration of the point that Amer-




THE QUIET EVENING AT HOME IS DISTURBED BY BILL

ica is not the only place in which retrenchment and curtailment is practiced at the present time he told me of an incident which occurred in a certain foreign plant in which he had worked before sailing for home.

"The big chief was a shark on efficiency. He had succeeded to power during the fat juicy days of the war when costs meant nothing and production meant everything. When the lean period succeeding those stirring four years arrived, he found that conditions were reversed and cost was the predominating factor. He immediately cut his operating force and was gratified to find that it was profitable in two ways, in his payroll and in his production. A smaller number of men meant a lighter payroll, but he also found that the smaller number of men actuated by the fear which impels the average man to hold fast to a vanishing job were hitting the ball so much harder than usual that production was not suffering to any extent.




SOME JOBS ARE EASIER THAN RAMMING SAND

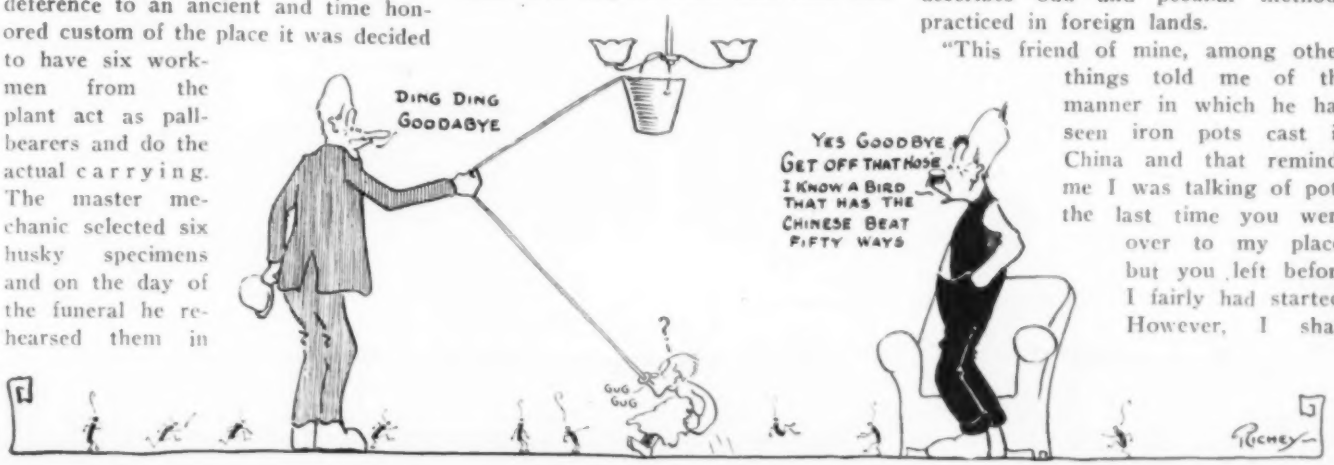
"Success in his first venture encouraged him to continue the policy of lopping men off from time to time, but before he had reached the ideal condition in which the plant could be operated without *any* men, he developed a case of the pip or some other equally dangerous malady and as they say in the ancient chronicles, he died and was gathered to his fathers.

"The obsequies were conducted in a manner befitting the important position held in life by the late lamented, and included among other features a set of honorary pallbearers. However, in deference to an ancient and time honored custom of the place it was decided to have six workmen from the plant act as pallbearers and do the actual carrying. The master mechanic selected six husky specimens and on the day of the funeral he rehearsed them in their duties and saw to it personally that they had washed the backs of their necks and behind their ears. He led them into the room and with a final admonition not to spit on their hands before grasping the silver handles he lined them up there on each side. Just as the funeral director's assistant approached to screw down the lid the late lamented poked his head up through the opening and glared around. His eyes fell on the six stalwart sons of toil and he wanted to know who they were and what they were doing there. The master mechanic explained they were representative of the few remaining workmen in each department: Tim Gallagher from the foundry; John McInnis from the blast furnace; Sandy McNab from the open hearth; Paul LeDuc from the rail mill; Ole Oleson from the blooming mill and Tony the Greek wop from the bessemer. The big man's face turned purple. 'Didn't I issue a general order last Wednesday', he shouted, 'to cut the operating force 33 1/3 per cent? Lay off two of these men, four will be ample for this job.' Then he expired in peace.

"One of the first impressions I received in the foundry, an impression that has been confirmed with the years that have elapsed since that time was that in every foundry one or more of the molders may be relied upon as adept wielders of the long bow. This term also has been modernized and I have been given to understand is now known as shooting the bull. However, the terms are the same and are applied to a trait of human nature which probably antedates the stone age. It does not require a violent effort of imagination to see a few of those choice old hairy spirits gathered in a cave of a rainy afternoon listening to a reconteur indulging in a little target practice. At that time the artist probably was referred to among his intimates as the boy with the auburn hair who handled an especially vicious sling shot. Personally I have known many otherwise estimable men who indulged in the short sport in moderation,—in fact at times I have been accused.—but never mind that now, —what I wanted to say is that there is a limit to everything and I told Bill that irrespective of whatever other countries his friend had visited there was no doubt in my mind but that he had lingered for a while in the land of Ananias and Saphira.

"Thank heaven," said Bill, "when a friend of mine tells me a thing I don't experience the necessity of testing the statement with a two-foot rule, a microscope or a spring balance, neither do I have an insane desire to pass it through a fine sieve with the secret hope of catching some of the coarse stuff. Besides I have seen so many queer stunts pulled off in some of the foundries in this country that I see no reason for doubting a man when he describes odd and peculiar methods practiced in foreign lands.

"This friend of mine, among other things told me of the manner in which he had seen iron pots cast in China and that reminds me I was talking of pots the last time you were over to my place, but you left before I fairly had started. However, I shall




BILL TRIES TO START SOMETHING BEFORE HE LEAVES

only comment on the Chinese method now and perhaps when you have more time to spare, I shall say a few words on the subject of pot molding and casting as it is practiced in this land of the free and prohibition.

"It is quite a story in itself of how this young American molder, stranded in San Francisco during the business depression of 1904, shipped on a British tramp loaded with contraband of war to be discharged at the Russian port of Vladivostok; of how the spirit of adventure caused him to desert the vessel the night she docked and of his troubles while hoboing through the interior of China for six months. However, there is no need of going into that now for I expect to have the pleasure of introducing you to each other one of these days and you will get it all at first hand.

"He lingered for a few days in a village that boasted of a blast furnace and foundry, but found that the methods pursued were radically different from those in any occidental community. The term blast furnace really is misleading inasmuch as no blast is employed to melt the iron. The iron ore is found in loose surface formation in the vicinity of the village. It is gathered into bags and carried to a designated point and smelted by natural draft in a number of clay cylinders filled with alternate layers of ore and charcoal. The cylinders, about 4 feet long by 8 inches diameter are set up vertically on a number of broken cylinders which serve as a grate. Charcoal is piled under and around them and set on fire. After the fire has burned out lumps of metallic iron ranging in size from shot to pieces as large as eggs are raked out of the ashes. Iron has been made after this manner in China for centuries and probably will continue to be made so long as China remains aloof from western civilization.

"The foundry methods are as archaic as those employed in smelting the iron from the ore. The principal objects produced in this particular foundry were wide, shallow iron pots in which the natives do most of their cooking. No flasks were employed, the molds being made entirely in the floor. A kind of natural cement which hardens in the air is used instead of sand for making the molds. The pattern is filled with the compound and then flopped upon a prepared bed in a hole in the foundry floor. The remainder of the hole is filled with compound and at the same time a runner about ½-inch in diameter is set on the pattern at the center and several smaller sticks set up at various points on the surface to serve as vent holes.

"After the compound has set the upper block is removed and if necessary retouched on the inside surface. Then the pattern is lifted out and the lower half of the mold is finished and made perfectly smooth. The mold then is re-assembled and after the joint has been daubed and a few weights set on it is ready to be poured. The castings produced in these molds are exceedingly thin, seldom exceeding ⅛-inch and the surface is as smooth as if they had been polished. The material employed for making the molds is of a highly refractory character and it is possible to use one mold many times before it is destroyed.

"The cupola used for melting the iron in this little foundry was not in use every day. It was made up of two cast-iron rings or cylinders each about 2 feet in diameter and each about 2 feet high. These rings were daubed with clay, dried and kept in the yard except on the days when it became necessary to run off a heat. On these days they were rolled into the foundry and placed one on top of the other on a plate covered with a dried coating of clay resting on the floor. The lower ring was provided with two openings one in front that served as a tap hole and another at the back for a tuyere. A small hole was dug in the floor immediately in front of the tap hole in which to set the ladles.

"After the charcoal bed was well burned through the iron and charcoal constituting the remainder of the charge was thrown in at the top. It was not charged in layers as we are accustomed to see it but thrown in apparently in an indiscriminate manner. However, experience has shown these melters that an approximate ratio must be maintained between the amount of fuel and iron and they display a high degree of skill in producing uniform highly fluid iron. Blast is furnished by a man pushing a feather piston back and forth through a section of bamboo open at one end terminating at the other end in a hard clay nozzle or tuyere located a few inches above the base plate and directly opposite the tap hole.

"The men work slowly and peacefully. Time is only a figure of speech and means nothing to them. They have no conception of working on a schedule or doing a certain amount of work in a definite time. They keep on molding until the floor is filled, then they set up the furnace and place enough iron in it to pour off all the molds. No attempt is made at continuous melting. The furnace is filled to the top at first but no further material is added after the iron commences to melt.

"The Chinese are not the only people who work slowly," I said. "I know some people around here who could give any Chinaman who ever wore a pig tail a week's start behind and then let the Celestial win in a walk. You started talking a month ago about the manufacture of cast-iron pots in America and here you are now lost somewhere in the interior of China. At the rate you are going the only kind of a pot I will be interested in by the time you are through will be one of those little urns they hand you at a crematory."

"If I were one of those heartless creatures," said Bill, "who delight in spearing their victims on the end of a long, cruel, pointed and sharpened remark I might say that any crematory attempting to burn you at a flat price would lose money. However, taking everything into consideration, your unfortunate condition and so forth, I simply will point out that to visualize a thing properly it must be viewed through a proper perspective. The high state of efficiency attained by present day western potmakers will be more easily appreciated when compared with Oriental methods."

## Agents for Aluminum

Rogers, Brown & Co., with offices in New York, Buffalo, Cincinnati, Cleveland, Boston, Philadelphia, Pittsburgh, Chicago and St. Louis, recently have been appointed agents in the United States for aluminum of various grades produced by the Norsk Aluminum Co., Christiana, Norway. Stocks of this material will be maintained in New York and in Cleveland.

## Philadelphia Firm Moves

F. J. Ryan & Co., builders of industrial furnaces, recently have removed from the Franklin Trust building to the Wesley building, 17th and Parkway, Philadelphia. The engineering department of this company has been removed to the Lancaster Iron Works, Lancaster, Pa.

L. G. Sullivan has been appointed to succeed Frank D. Moffat, deceased, as manager of the New York office of the Atlas Steel Casting Co., Buffalo. The New York office of the company is at 200 Fifth avenue.

# British Foundrymen Hold Meeting

## Annual Conference at Blackpool Reflects Strength of British Castings Industry —Cablegrams Exchanged with America—Much Interest in Problem of Making Gray Iron in Electric Furnace

BY H. COLE ESTEP
*European Manager,* THE FOUNDRY

FURTHER consolidation of its already strong position in the castings industry of the United Kingdom, coupled with the inauguration of definite co-operation with the American Foundrymen's association through an exchange of papers, constitute the outstanding features of the eighteenth annual meeting and conference of the Institution of British Foundrymen, which was held at Blackpool, England, Sept. 14-16. The meeting was largely attended and the growing strength of the Institution was evident throughout the proceedings. Officers were elected for the ensuing year, and in the new president, Oliver Stubbs, of Joseph Stubbs, Ltd., Manchester, the institution will have the benefit of the services of a foundryman and business leader of wide experience to carry on the important work initiated by the retiring president, Matthew Riddell, Watson Gow & Co. Falkirk, Scotland, and his predecessors. On the technical side, the papers and discussions centered around the metallurgy of cast iron and the intricacies of cupola practice. The leading paper on the program was contributed on behalf of the American Foundrymen's association by George K. Elliott, Lunkenheimer Co., Cincinnati thus marking the commencement of the formal exchange of papers between the American and British associations arranged some time previously. Mr. Elliott's paper was enthusiastically received, and its presentation led to an exchange of congratulatory cablegrams between the Institution of British Foundrymen and the American Foundrymen's association. The text of these messages is presented on an adjoining page. It was announced at the Blackpool meeting that the return paper on behalf of the Institution of British Foundrymen will be presented at the next meeting of the American Foundrymen's association by F. J. Cook, Rudge & Littley, Ltd., West Bromwich, near Birmingham. The meeting opened Wednesday morning, Sept. 14, at the Central Library, Blackpool, with Matthew Riddell, the retiring president, in the chair. An address of welcome was made by C. W. Callis, J. P., Mayor of Blackpool, supported by Alderman Joseph Heap. Mr. Riddell responded briefly for the Institution of British Foundrymen. A message of sympathy was telegraphed to W. Mayer, Dumbarton, Scotland, past president, who was unable to be present on account of serious illness.

The report of the general council showed a membership of 1620 as compared with 1603 last year. The Scottish section with 301 members, continues the largest of the eight branches through which the affairs of the institution are administered. A new branch is being formed at Bradford. Negotiations for a royal charter are proceeding. The institution is participating in the work of the British Cast-Iron Research association which it was instrumental in organizing, being represented on the governing body of the Research association by the following members, F. J. Cook, M. Riddell, J. Cameron, R. O. Patterson, and Oliver Stubbs. Mr. Riddell is vice chairman of the council of the Research association.

The names of the new officers, who were elected at Blackpool, are given on an accompanying page. The elections were unanimous. Six new members of the general council also were elected. The trustees, R. Buchanan, F. J. Cook and W. Mayer, and the venerable treasurer of the institution, F. W. Finch, were re-elected unanimously, as was the general secretary, F. W. Hollinworth, 5 Duke street, London, W. C. 2. According to custom an illuminated address was presented to John Little, Manchester, past president for the year 1919-20. The new president, Oliver Stubbs, was conducted to the chair and formally invested with the chain of office by the retiring president, Mr. Riddell. In his presidential address, which appears on the succeeding page, Mr. Stubbs emphasized the essential unity which should exist between the technical and business sides of the foundry industry, and the opportunity which is presented to the Institution of British Foundrymen to cement "the feeling of conciliation which is now in the air," between employers and employes. Mr Stubbs also announced that the National Ironfounders Employers' federation, of which he is president, has voted £200 per year for medals and awards to be presented through the

OLIVER STUBBS

Mr. Stubbs, who has been elected president of the Institution of British Foundrymen for the year 1921-22, is joint managing director of Joseph Stubbs, Ltd., iron founders and manufacturers of textile machinery, Manchester, England. He comes of a well established family which has long been noted for engineering talent and business ability, and is himself a thorough Briton of the modern progressive type. He is president of the National Ironfounders Employers' federation, and a member of the council of the British Cast Iron Research association. He is also a member of the Institution of Mechanical Engineers, and numerous other technical, business and social organizations.

Institution of British Foundrymen for distinguished services to the British foundry industry. The Scottish branch is also awarding gold and silver medals donated by Past-president Mayer. The decision to hold the 1922 meeting in Birmingham in June, in conjunction with the first British exhibition of foundry supplies and equipment, was formally ratified by the Blackpool conference. Mr. Elliott being unable to be present, his paper entitled "The Basic-Hearth Electrical Furnace and Some Problems of Cast Iron," was read by T. D. Robertson, chief engineer, Electro-Metals, Ltd., London, W. C. 2. The paper has already been published in the Sept. 15 issue of THE FOUNDRY. The discussion, which was exceedingly interesting, will be presented in a later issue of THE FOUNDRY. After Mr. Elliott is given an opportunity to reply, the points he raised will be further discussed by the several branches of the British institution at their autumn meetings.

The discussion at the Blackpool meeting was opened by Mr. Riddell, who said Mr. Elliott's paper is a small textbook on melting iron. The main question raised by successive speakers was whether under British conditions, sufficiently good iron cannot be melted in the cupola to meet any requirements to which cast iron should be subjected. The difficulty of obtaining high degrees of superheat in the cupola was generally admitted, but it was stoutly contended that sufficiently good results could be obtained without incurring the extra expense of duplexing.

John R. Hyde, Robert Hyde & Sons, Ltd., Sheffield, pointed out that the duplexed castings cited by Mr. Elliott are equalled in strength by good British cupola iron, which has a transverse strength on the British test bar, 2 x 1-inch on 36-inch centers, of 3360 pounds,

W. B. HOLLINWORTH, SECRETARY

the American round arbitration bar with 12-inch centers giving results 20 per cent higher than the longer English bar. He agreed that strength is a function of casting temperature, citing tests on the American arbitration bar, which he had made, showing a strength of 4032 pounds when poured immediately and only 3808 pounds when the metal was held seven minutes in the ladle.

H. J. Young, Northumberland Marine Engineering Co., Wallsend-on-Tyne, mentioned tests on thousands of arbitration bars showing strengths of 3808 pounds and upwards, adding that 30 per cent of his castings contained 0.14 per cent or more of sulphur. He defended high sulphur saying good castings can be made with 0.20 per cent sulphur, and doubted if there is much chance of the sulphur in the world's scrap pile increasing to dangerous proportions owing to the difficulty in increasing the sulphur in castings over 0.20 per cent even when trying to do so deliberately.

J. Shaw, Brightside Engineering & Foundry Co., Sheffield, pointed out that, admitting the superheating possibilities of the electric furnace, with good cupola working one can obtain a temperature hot enough for any casting, and as high as most sand will stand up to. The possible refining action of the electric furnace constitutes its chief claim for attention. But sulphur reduction and deoxidation do not alone account for the increases in strength cited by Mr. Elliott. The alteration of graphitic carbon to the temper form also is an important factor.

Prof. E. H. Desch, University of Sheffield, asked why not go further and use steel, and J. Arnott, G. & J. Weir, Ltd., Glasgow, said malleable and steel castings being more ductile, cast iron should be prohibited for high-pressure steam fittings. F. J. Cook, Rudge & Littley, Ltd., West Bromwich, pointing out that American castings contain only 0.5 per cent phosphorus against 1.0 per cent in English iron, stated that nevertheless the English metal is stronger.

Mr. Riddell referred to an interesting method of getting hotter, and hence stronger, iron from the cupola by wetting the coke. He advocated water to the extent of 15 per cent of the weight of the fuel, with a melting ratio of 168 pounds of coke per ton of 2240 pounds of charge, without the bed. This wetting, he said, concentrates the melting zone, and by keeping down the temperatures in the upper zones prevents carbon absorption by the iron passing down. Thus more effective fuel reaches the melting zone and the total carbon in the iron is kept down. Very thin, long castings can be produced in this way, he said.

Replying to the discussion on behalf of Mr. Elliott, T. D. Robertson pointed out that the electric furnace is not a substitute for the cupola but should be used where cupola castings will not meet the specifications, many cases of this sort arising. Also the electric furnace makes possible the use of cheaper raw materials. Good English cupola iron could be improved by duplexing, he maintained, the increased strength obtainable being due to high casting temperature rather than to reduction of sulphur or oxygen. He suggested the possibility of shorter

## New I. B. F. Officers

1921-1922

**President**
OLIVER STUBBS
Joseph Stubbs, Ltd., Manchester

**Senior Vice President**
H. L. REASON
United Brass Founders & Engineers, Ltd., Birmingham

**Junior Vice President**
H. JEWSON
Hobbies, Ltd., Dereham

**Honorary Treasurer**
F. W. FINCH
Gloucester

**General Secretary**
WILLIAM G. HOLLINWORTH
5 Duke street, London, W. C. 2

**Members of General Council Elected at Annual Meeting**

E. H. BROUGHALL, Edgwick Foundry, Coventry; J. CAMERON, Cameron & Robertson, Kirkintilloch, Scotland; W. H. COOK, Stockport; CAPT. A. HAYES, London; BENJAMIN HIRD, G. Cash & Sons, Portsmouth; H. JEWSON, Hobbies, Ltd., Dereham; T. W. MARKLAND, Harwood; H. PEMBERTON, Derby; J. G. ROBINSON, Halifax; J. SHAW, Brightside Foundry & Engineering Co., Sheffield.

## By Cable

*The following is the text of the cablegrams exchanged between the Institution of British Foundrymen and the American Foundrymen's association, on the occasion of the formal inauguration of the exchange of papers, at the Blackpool meeting of the British institution, Sept.* 14-16:

(1)

Secretary,
American Foundrymen's association,
Chicago, Ill.
Behalf officers, council, members assembled annual meeting accept deepest appreciation excellent paper contributed George Elliott. Advise author. Best wishes.
(Signed) Institution British Foundrymen.

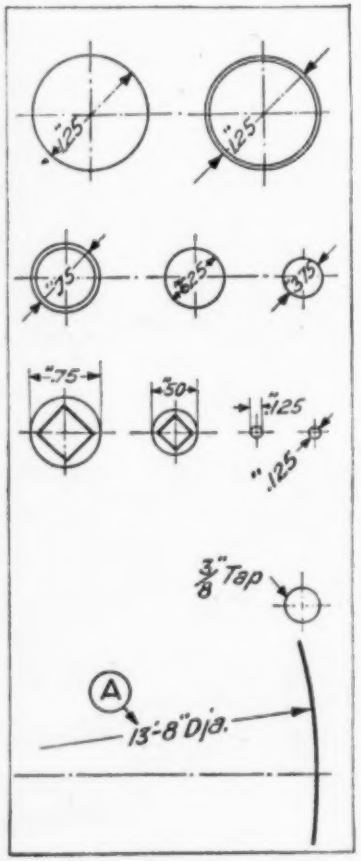
(2)

Oliver Stubbs, president,
Institution of British Foundrymen,
Blackpool, England.
Behalf officers members send greetings, best wishes successful meeting; may exchange inaugurated long continue.
(Signed)
American Foundrymen's association.

THE FOUNDRY DATA SHEET, OCTOBER 15, 1921

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

## STANDARD METHODS FOR DIMENSIONING DIAMETERS




When there is clear room for the dimensions without interfering with the center lines of the circle.

When breaking the center lines of the circle leaves clear room for the dimension.

When for any reason it is not desirable to place the dimension within the circle.

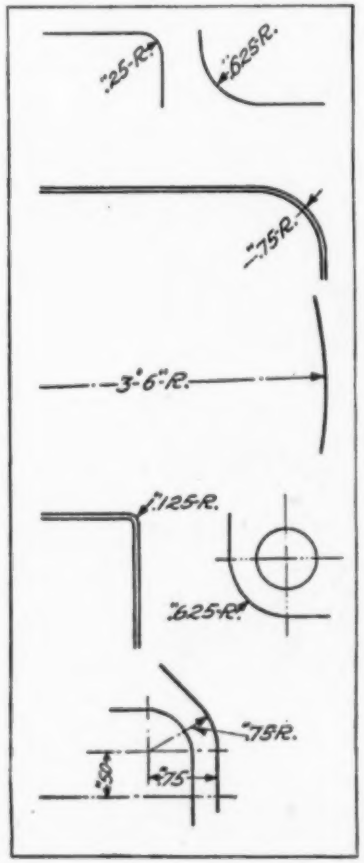
When it is desirable either to give or indicate the diameter in a note.

1:—When there is clear room for the dimension, but it is either impossible or undesirable to show the complete diameter.

2:—When there is any possibility of the dimension being mistaken for a radius.



## STANDARD METHODS FOR DIMENSIONING RADII




When there is clear room within the curve for the dimension and arrow head.

When there is clear room within the curve for the dimension, but an inside arrow head would touch some other line of the drawing.

When the position of the center is unmistakable and there is clear room for the dimension, but it is either inconvenient or undesirable to show the complete radius.

When the position of the center is unmistakable and there is not clear room within the circle for the dimension.

When the center has to be located and there is not clear room within the curve for the dimension.



Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

electric furnace treatment, say 120 to 150 kilowatt hours per ton, current in Sheffield for instance being 1.15 pence (1.7 cents) per unit.

V. C. Faulkner, editor, *Foundry Trade Journal*, London, said that gray iron foundrymen installing electric furnaces would have the benefit of all the experience, especially as to design and construction of apparatus, accumulated by the steel foundrymen. John R. Hyde endorsed the benefits accruing from sulphur reduction. J. E. Hurst, Hadfield, near Manchester, said undue importance is attached to the effect of iron oxide. Higher temperature, coupled with lower total carbon and sulphur accounts for the admitted superiority of electric-furnace gray iron.

SOME OF THE BUNCH FROM LANCASHIRE

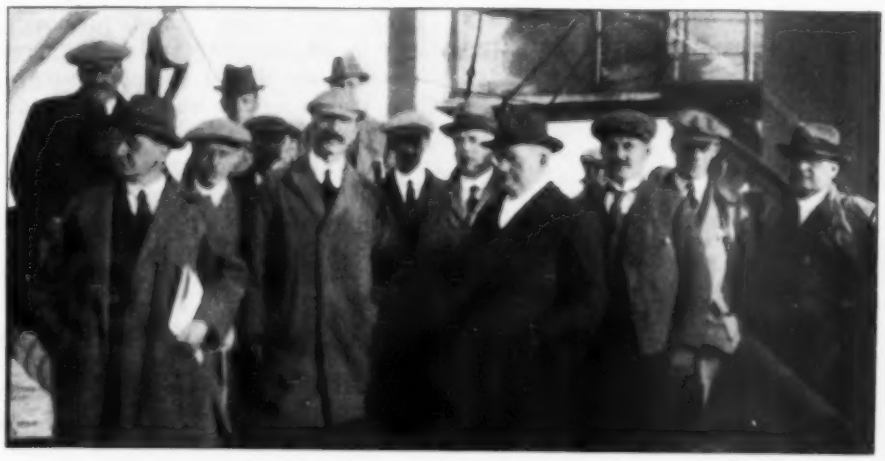
Under the general title, "Some Perplexing Foundry Problems", J. Shaw, Brightside Foundry & Engineering Co., Sheffield, in the second paper presented at the Blackpool meeting raised interesting metallurgical questions in connection with pig-irons in which the physical characteristics are apparently at variance with the analysis. He mentioned one such iron containing 0.18 per cent silicon, which was perfectly gray, and made satisfactory machinable castings. Mr. Shaw's paper was published in THE FOUNDRY Sept. 15.

AT THE RUINS OF FURNESS ABBEY

The discussion opened the old controversy between the so-called practical men and the scientists as to whether pig iron contains "inherent qualities" which affect its characteristics independently of analysis. The consensus of opinion seemed to be that these "inherent qualties", which result for instance in gray iron with absurdly low silicon are really due to definite scientific causes, only the methods of investigation and analysis at the disposal of metallurgists today do not permit obscure factors to be fully investigated or controlled, which is one reason why experience is still a valuable asset to men charged with getting results in the foundry.

The question of oxygen in pig iron, based largely on the researches of the late J. E. Johnson Jr., naturally came in for considerable attention in discussing Mr. Shaw's paper. H. P. Mason, engineer, Peterborough, said that cast iron is occasionally badly oxidized in the cupola, oxidation being difficult to avoid in some cupolas with low silicon iron unless the manganese is under 0.5 per cent. H. J. Young pointed out the difficulty, from the scientific standpoint, of accurately analyzing cast-iron or in stabilizing the melting factors in such an instrument as the blast furnace or cupola. Prof. Desch said it by no means follows that because silicon is present in molten metal and reduces iron oxide, that oxygen must disappear from the molten mass. Dr. J. E. Stead, president, British Iron and Steel Institute, Middlesbrough, said that Johnson's conclusions that oxygen over 0.05 per cent benefits cast iron are sufficiently important to justify exhaustive research.

H. E. Diller, metallurgical editor, THE FOUNDRY, said that Johnson's conclusion's have not been generally commercialized, adding that the deleterious effect of oxidation is generally admitted. Other discussions were contributed by R. Buchanan, Birmingham; J. Arnott, Glasgow; D. Wilkinson, Birmingham; Dr. Richard



THE DELEGATION FROM BIRMINGHAM

Moldenke, Watchung, N. J.; G. K. Elliott, Cincinnati; and E. Ronceray, Paris, France. Further abstracts of these discussions will be published subsequently.

In concluding the discussion Mr. Shaw said that in properly operated foundries, the composition of the charges, cupola practice, casting temperatures, test-bar molding, etc., are all stabilized, within the limits of human accuracy, yet inconsistent results sometimes appear. They are due, he believes, to qualities in the pig iron resulting from irregular blast-furnace operation, especially holding the metal in the hearth at high temperature for considerable periods of time, these temperatures apparently being such as to impart qualities not affected by the cupola remelting temperatures.

The entertainment program was inaugurated by a municipal reception held by the mayor of Blackpool, at the town hall, Wednesday afternoon, Sept. 14. The eighteenth annual banquet of the I. B. F. took place the same evening at the Palatine hotel. Friday, Sept. 16, was devoted to an all-day excursion to the naval construction works of Vickers, Ltd., at Barrow-in-Furness. Luncheon was served at the Furness Abbey hotel, Joseph Stubbs, Ltd., being the hosts. Vickers, Ltd., were represented by G. H. Banister, Commander C. W. Craven, and H. Fender, directors. After inspecting the works, tea was served by the Vickers company, the party returning to Blackpool in the evening via special steamer and chartered cars.

# British Industry Strong and Confident

BY OLIVER STUBBS

IN COMMON with many other industries, the British foundry trade recently has passed through a strenuous time, through dark days when perspective was for a time blurred and the outcome could not be foreseen. Through causes almost too numerous to name, embracing a number of factors over which the industry has had no control, the foundry business has succeeded from an unprecedented period of inflation to a time of depression which has had no parallel in the world's history. This slump has been hard to face; it has been hard to fight through; and our business is not yet out of the woods but we must not lose heart. Rather should we take advantage of the times to put our house in order so that when better times come as in the cycle of trade conditions is inevitable, we shall be able to hold our own both at home and abroad. I am strongly of opinion that both employer and employe must get to know each other better. Already there is a feeling of conciliation in the air. The old hereditary antagonism that existed is disappearing, and by rubbing shoulders we are obtaining the other man's viewpoint to our mutual advantage. After all, what is success worth if it is not shared by all those who have helped to bring it about?

### *The Question of Education*

It will pay us to consider the causes which have kept our industry from progressing as we would have wished it. Do we get the best class of apprentices, and if not, why? I venture to suggest that we have not made our foundries and the trade sufficiently attractive. We may not in the past have given sufficient thought to the training of apprentices. The whole system of the continuation of their education between the ages of 14 and 16 wants very careful consideration and thought. There is an old saying, "Catch 'em young." When the youth is at his most receptive age we should see that the knowledge which is then imparted to him will not only make him a better craftsman but will broaden his outlook and make him a better citizen. I am a great believer in the efficient training of apprentices, because I fully believe that by strict attention to this matter the ultimate success of the industry will result. In some cities the education authorities have recognized the wisdom and benefits accruing from the promotion of junior technical schools where the education of boys is continued between the ages of 14 and 16.

In Manchester there are two such schools, and the possibility of an addition to this number in the near future. The employers have representation on the local committees of management. The school work is being carried out in a thoroughly practical manner. Visits to local works and foundries are arranged for the boys and modern plant, loaned by the employers is at their disposal for study. As I have stated previously, it is in the receptive years of a boy's life that we should endeavor to give him the best and most efficient education possible.

The British Cast Iron Research association, as a result of steps taken in 1919, has now been formed and incorporated. This result must be extremely gratifying to all members of the Institution of British Foundrymen, as it was largely owing to the interest taken by them in the early stages that the Research association was formed. It took a war to bring about a due realization in the country of the value of research to industry. Prior to the years 1914-1918 the universities were too academic and were loth to associate themselves with trade or industry in any shape or forms. Today the attitude adopted is a totally different one and the closest association now exists between what one may term the technical scientist and the producer.

The Research association is already at work, and is dealing with problems submitted by foundries who are members. The following list of research work will emphasize the importance and utility of the association:

### *Nature of Investigation*

Research No.

1.—Analysis and cupola mixtures suitable for castings subject to growth during service.

2.—Abnormal structures in malleable iron castings—Composition of metal and best treatment to overcome same.

3.—The elimination of shrinkage defects in gray-iron castings.

4.—The curing of hard white cores in the interior of gray iron castings.

5.—The composition and treatment of ganister and other cupola and furnace lining refractories.

6.—The use of steel and iron turnings in cupola charges.

7.—Investigation concerning composition of stucco and plaster patterns for machine molding.

8.—Molding and facing sand mixtures for light castings in green sand.

9.—Molding and facing sand mixtures for semisteel castings.

10.—The correct analyses of semisteel for light, medium and heavy castings. The rationale of mixing, charging, full ratio air supply and casting temperature for semisteel work.

11.—Cupola coke analysis and physical composition as influencing hardness of iron produced.

12.—Preliminary stages in pig iron grading problem.

13.—Fundamentals in design of annealing furnaces for malleable castings.

14.—Internal casting strains in castings and their correction.

15.—Cast iron of suitable composition to resist erosive and corrosive action as in centrifugal pumps, valves, pipes, etc.

In the investigation of these problems samples of a satisfactory and unsatisfactory or defective character are being collected. Chemical, microscopic, physical and heat treatment tests are being carried out and a thorough investigation made. Reports are duly issued to members covering the tests carried out.

*America in the Forefront*

We should consider the fact that in Great Britain there are something like 3000 foundries and at one time we were the largest producers of malleable cast iron in the world. Our output today of 66,000 tons per annum is less than it was some years ago. From the foundries of our American friends, 1,500,000 tons of malleable iron is turned out per annum, or an average of 100 tons per week per foundry against our average of eight tons per week per foundry. Today we are purchasing large quantities of pig iron, to say nothing of large amounts of iron and steel castings from abroad. It behooves, us, therefore, to give our wholehearted support and assistance to the British foundry industry if we are to improve conditions and maintain or better our position in the world's markets. It is not a question today of the lone hand. There must be complete cooperation in every foundry and throughout every workshop.

## Census of the Cast Iron Pipe Industry

A preliminary statement of the 1920 census of manufactures with reference to the cast-iron pipe industry has been prepared by the United States bureau of census. This consists of a detailed statement of the quantities and values of the products manufactured during the year 1919. The accompanying table showing a comparison of production and values in 1919 with those of 1914 indicates a decrease in tonnage in 1919 compared to 1914 of 37.3 per cent, with an increase of 86.7 per cent in total value, the average ton value being $69.55 in 1919 and $23.18 in 1914.

## Determines Properties of Magnesium Alloys*

*By S. Beckinsale*

Several samples, of German origin, of the magnesium alloy known as *electron* have recently been examined, and the following brief account of its properties may serve to amplify information lately published about high magnesium alloys.** The specimens were in the form of cylindrical rod 0.3 inch in diameter.

CHEMICAL ANALYSIS

| | A | B | C |
|---|---|---|---|
| Copper, per cent | 9.20 | 0.52 | 0.53 |
| Zinc, per cent | 4.62 | 4.24 | 4.37 |
| Magnesium per cent (by difference) | 95.18 | 95.34 | 95.01 |
| Tin, manganese | nil | nil | nil |
| Lead, iron, aluminum | trace | trace | trace |

SPECIFIC GRAVITY

| A | B | C |
|---|---|---|
| 1.78 | 1.79 | 1.79 |

BRINELL HARDNESS TESTS
(1 mm. all; 10 kg. load)

| | A | B | C |
|---|---|---|---|
| Exterior surface | 51 | 51 | 63 |
| Transverse section | 50 | 48 | 59 |

TENSILE TESTS

Diameter of test-piece, 0.180 inch. Elongation measured on 0.64 inch (=4 √area).

| | A | B | C |
|---|---|---|---|
| Ultimate strength, pounds, per square inch | 36,060 | 40,320 | 41,220 |
| Yield point (by dividers), pounds per square inch | 26,880 | 17,020 | 26,880 |
| Elongation, per cent | 19 | 19 | 13 |
| Specific tenacity | 250 | 278 | 284 |

COMPRESSION TESTS ON CYLINDERS
(0.31 inch diameter, 0.31 inch long)

| | A | B | C |
|---|---|---|---|
| Yield point, pounds per square inch (compression 0.5 per cent with load on) | 6,720 | 13,440 | 18,820 |
| Permanent reduction in length at— | | | |
| Loads of 22,400 pounds per sq. in. % | 3.9 | 2.0 | 1.0 |
| Loads of 44,800 pounds per sq. in. % | 10.1 | 9.1 | 7.1 |
| Crushing load, pounds per square inch—fracture occurred by shearing | 51,520 | 49,950 | 53,340 |

All samples showed equi-axial polyhedral crystals of a single solid solution. One end of sample C, which had been headed, showed distortion of the grains. These were elongated in the direction at right angles to the axis of the rod.

The specimens were polished on fine emery paper impregnated with paraffin wax followed by selvyt, to which a little metal polish had been applied. The specimen, to which a trace of polish adhered, was then transferred to clean selvyt.

A satisfactory etching agent was a solution of 1 per cent hydrochloric acid and 0.5 per cent nitric acid in alcohol.

Machining properties of the alloys were satisfactory, and a good finish was produced by shaping or turning. It may be remarked that on account of the danger of fire the manufacturers issued strict regulations to prevent the accumulation of turnings beyond a certain amount in the factories where these alloys were machined.

The samples of *electron* examined contained about 95 per cent of magnesium, 4.5 per cent of zinc, and 0.5 per cent of copper. They were in the form of rod, probably extruded at a raised temperature; one sample showed evidence of having been subjected to cold heading. The alloys machined well, and compared favorably with aluminum alloys in tensile properties (allowance being made for the much lower specific gravity), but they were not so ductile in compression.

*Paper presented at the meeting of the British Institute of Metals held in Birmingham, Sept. 21 and 22, 1921.

** "Magnesium and Its Alloys," *Engineer*, 1919, vol. cxxvii. p. 402. T. Blackwood Murray (Presidential Address to the Institute of Engineers and Shipbuilders of Scotland), *Metal Industry*, 1920, vol. xvi. p. 512. "The Casting of Electron Metal," *ibid.*, 1920, vol. xvii. p. 107. "Metallic Magnesium," *ibid.*, 1921, vol. xviii. p. 426.

## Acquires New Interests

Negotiations have been virtually completed by the American Radiator Co. for the purchase of a large interest in the Fox Furnace Co., Elyria, O. The holdings of Henry Wick the heaviest stockholder who has decided to retire have been taken over. No change is to be made in the name, product or organization, except that L. T. Woodrough has been put in charge of the company.

The Titanium Alloy Mfg. Co., Niagara Falls, N. Y., has opened its physical metallurgical and metallographic laboratories to commercial service. The physical laboratories comprise a testing department, metallographic department, a room for experimental heat-treating and a small experimental foundry.

## Summary Concerning the Cast Iron Pipe Industry

| Kind | 1919 Short tons | 1919 Value, dollars | 1914 Short tons 2000 lbs. | 1914 Value, dollars |
|---|---|---|---|---|
| *Total value of products | .... | 51,902,800 | ..... | 28,102,600 |
| Cast iron pipe and fittings | 702,550 | 48,514,600 | 1,120,720 | 25,979,200 |
| Gas and water pipe and fittings | 447,880 | 28,124,100 | 909,070 | 19,805,500 |
| Bell and spigot pipe | 375,200 | 19,257,700 | 828,900 | 16,669,600 |
| Flanged pipe | 23,790 | 1,714,200 | 27,290 | 706,500 |
| Culvert pipe | 5,660 | 344,000 | 11,010 | 246,500 |
| Fittings | 43,230 | 6,808,200 | 41,870 | 2,182,900 |
| Soil and plumbers' pipe and fittings | 254,670 | 20,390,500 | 211,650 | 6,173,370 |
| All other castings | 16,400 | 1,614,500 | 13,580 | 681,700 |
| All other products | ..... | 1,773,700 | ..... | 1,441,700 |

*Includes 59 establishments primarily engaged in the manufacture of cast iron pipe with products valued at $50,235,100 in 1919 and $26,659,360 in 1914; and seven establishments in 1919, and nine in 1914 in other lines of manufacture, reporting cast iron pipe to the value of $1,667,700 and $1,443,240 respectively.

# How To Sell the Shop Safety Idea

## Plan Described as Carried Out by Large Company Where a General Joint Committee with a Secretary of Safety Controls the Work Through Shop Committees—Competition Between Departments Fostered

SAFETY ideas for adaption in industry, must be sold just the same as any commodity, according to N. M. DuChemin, secretary of the safety committee at the Lynn works of the General Electric Co., in a paper presented at a meeting of the New England Foundrymen's association recently. The price asked, according to Mr. DuChemin is the personal effort of each employe in the plant. The prize offered is health, and a sound body. The campaign of selling the idea of safety is much like any campaign for selling goods. There must be advertising. A desire on the part of the purchasers must be created and a price must be demanded. At the General Electric Co. a safety committee plan has been in operation for a little over a year, and during this time the number of accidents resulting in the loss of time has decreased from nearly eight per hundred men per year to approximately five, or a decrease of 40 per cent. Therefore, the methods have proved successful, and a study of the organization may be of benefit to other plants.

First a definite organization was established. This organization consists essentially of joint committees. A general joint committee consisting of heads of the plant, and representatives of the operatives holds final authority, and is the body to which all major questions are referred. Reporting to this committee is the secretary of safety, who has in charge the active management of all safety work. Under his direction are a series of shop joint committees, each such committee controlling a division of a plant known as a shop and including approximately 800 workers. These shops usually contain several different departments and each department has a further joint committee. Under the direction of each department joint committee, is an inspector who lists among his duties the inspection of all apparatus in the department in question. The joint committees usually are composed of three men from the executive forces and three workmen.

### *Display Sells the Thought*

Illuminated boards are placed in each shop. These, as Mr. DuChemin says, are the shop windows of the safety organization. The displays must attract attention, and must through the messages they contain, gain the co-operation of employes in the work of reducing accidents. Just as in any selling campaign, special drives in safety work often are effective. Thus interest and enthusiasm are created by a no-accident day, or week, and by charts showing the progress made in reducing accidents from month to month.

Competition between different departments is an excellent means of creating interest. Scattered throughout the whole plant, in addition to the illuminated boards, small black-boards are placed containing slogans and notices, and usually the number of days which a department has been without an accident. The men take a great interest in the different slogans which often are changed daily. Motion pictures have been used successfully to add to the effort of advertising the safety idea. Sometimes the workmen's wives are invited to see the films, as it is considered important that the workers' families be educated to the idea that the plant management is attempting to keep the husband from being hurt, and that the plant is not, as is so often supposed, a soulless machine which of necessity injures some of its workers.

At Lynn, Americanization schools are conducted for the employes. At first this work was carried on inde-

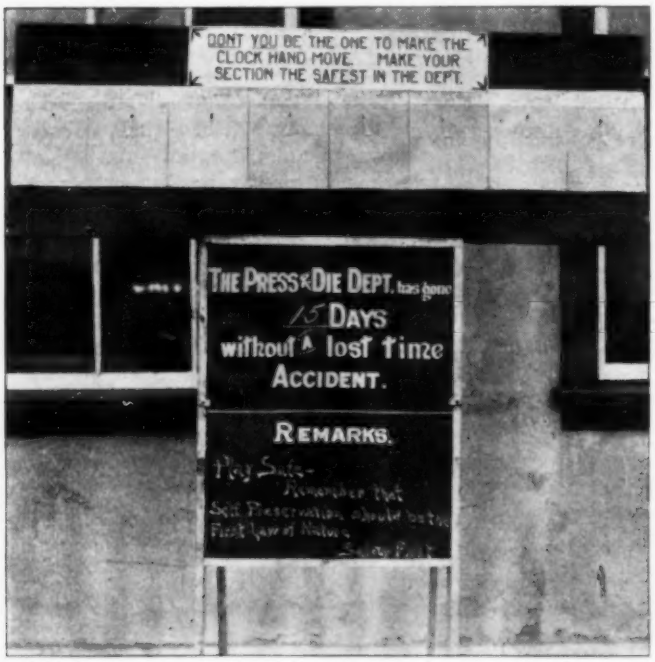

DONT YOU BE THE ONE TO MAKE THE CLOCK HAND MOVE. MAKE YOUR SECTION THE SAFEST IN THE DEPT.
THE PRESS & DIE DEPT. has gone 15 DAYS without A lost Time ACCIDENT.
REMARKS.

FIG. 1—BLACKBOARDS LIKE THIS ARE SCATTERED FREELY THROUGHOUT THE SHOPS OF THE GENERAL ELECTRIC CO. AT LYNN, MASS. FIG. 2—ILLUMINATED BULLETIN BOARDS CONSTITUTE THE SHOP WINDOWS OF THE SAFETY COMMITTEES

pendently of the safety work, but it has been found valuable to have close co-operation between the two departments. In teaching beginners English, it is found to be just as easy to use the safety slogans and safety information, as to use the old primer style of reading material. In this way the foreigners not only come to learn good English, but safety ideas are drilled into them from the start. Graduates of these schools are in many cases developing into the best type of employes. One of the best mediums for advertising the safety idea is a plant organ. At Lynn, a 14-page house organ issued every two weeks carries at least a full page of safety advertising. This page is given much thought as to arrangement and subject matter, and carries in each issue some definite message, to the readers. The fundamental facts underlying the safety work cannot be stated too many times, and part of the work of the safety organization is to sugar-coat these facts so they are more palatable.

# How and Why in Brass Founding

**By Charles Vickers**

## Porosity in Aluminum Die Castings

*We have been making aluminum disc castings, 23 inches in diameter, with 3/8-inch solid web. We have found many small holes in them which render them worthless. We have used advertised brass fluxes without success. The metal is scrap automobile crank cases and it is melted in a coke-fired pit furnace in a crucible.*

If the molds are poured with aluminum as cool as it is possible to have them run properly there will be no trouble from porosity. It is important to have it set as quickly is possible, once it has filled the molds. Nothing is gained by pouring the aluminum so hot it lies for a comparatively long period in the mold, and shivers away from the damp sides.

No flux need be used on the top of the metal in melting aluminum. Such are harmful, especially should the aluminum happen to get above its normal heat. Abandon the use of the fluxes mentioned, and instead, after the aluminum is melted and a few minutes before removing it from the furnace, scatter on the surface a pinch of solid chloride of zinc, then stir. This will separate the dross from the aluminum, and clarify the latter. Chloride of zinc is a good flux to use. Add a level spoonful to a pot of metal.

## Light Alloys Sought

*We have heard a great deal lately about a new alloy which is supposed to be lighter and cheaper than aluminum, and which is being used for both sand and die castings with success. We would like to learn if this alloy is patented and if so where it can be purchased; also what is the composition of this metal.*

Any alloy that is lighter and cheaper than aluminum would be covered with patents in every civilized country. There is no such alloy and it is unlikely there ever will be. The only metal that is lighter than aluminum and that is being used for castings is magnesium; and while this metal has lately receded in price it is still quoted at from $1.20 to $1.25 per pound in 100-pound lots. In the form of alloys such as Dow metal it would no doubt cost about $4 per pound.

The specific gravity of aluminum is 2.7, that of magnesium 1.69; potassium is about half this weight and sodium a little more than half, while calcium, with a specific gravity of 1.54, also is lighter than magnesium. However, none of these metals can be considered as foundry metals, as they are too active chemically. It can be decided that the alloy in question is neither cheaper nor lighter than aluminum, that it is in fact simply an alloy of aluminum, possibly with zinc, for in this latter case an alloy of zinc and aluminum can be made that will be cheaper than aluminum, according to the amount of alloyed zinc, but it also will be much heavier, and as these castings are sold by weight the greater specific gravity of the alloy might more than offset the few cents saved per pound because of its cheapness.

## Melting Loss of Brass

*Can you give us any information regarding the losses that will occur in melting an alloy consisting of copper, 60 per cent; zinc, 30 per cent, and tin, 10 per cent? Also any data or reference regarding the losses in melting other nonferrous alloys.*

Metal losses in melting vary with the type of furnace and the care exercised in operating the furnace. In melting yellow brass a reasonable figure for loss is 6 per cent of the zinc used, which would make the melting loss of the alloy given as 1.80 per cent. When the gates and the scrap are melted there will be a further loss and it can be figured that the total metal loss of the above alloy, figured from the new metal to the finished product, will be 10 per cent of the zinc content; making the total loss on the above alloy as 3 per cent.

In bulletin No. 73 of the United States bureau of mines the average melting loss of all metals is put at 2½ per cent, which means a 5 per cent loss on the metal bought. Particulars regarding melting practice and losses may be obtained from bulletin No. 73, which can be obtained from the superintendent of documents, government printing house, Washington, D. C. The price is 45 cents a copy.

## Alloy for White Bronze

*What are the component parts of the mixture known as white bronze, an alloy used in repair shops in this vicinity for automobile bearings?*

The so-called white bronze is an alloy of zinc and tin with sometimes a little copper. Whether the alloy referred to is the same or not we have no means of knowing as these names are applied through metallurgical ignorance to alloys of entirely different composition. The following mixture make a good ordinary white bronze:

WHITE BRONZE

| | Pounds |
|---|---|
| Tin | 64.50 |
| Zinc | 32.00 |
| Sheet Yellow Brass | 3.50 |

WHITE BRASS

| | Pounds |
|---|---|
| Tin | 60 |
| Zinc | 38 |
| Antimony | 2 |

White bronze or white brass as it also is called makes a good bearing, but it is sticky to work and may have to be plastered into the bearing. It then should be peaned before it is bored out.

# THE FOUNDRY

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## It's Up To the Shop To Win

WITH demand, that vital element in the well known inseparables, supply and demand, again creeping back into existence, a new condition confronts every jobbing foundry. Customers for many weeks have put forward tentative inquiries, backed mainly by price interest. The few contracts that have been forthcoming have been allotted after the keenest scrutiny of competitive bids. A gray iron medium-weight production job recently was let in an eastern city at $66 a ton and the prices offered by foundries in the locality ranged from the figure stated to $94. True, the successful contender for the work had charged off his high priced iron and coke, but so had some of the competing firms. The price contracted may have been ruinously low; but the work was taken upon the assurance of the superintendent that he could so rig the job that he could get a larger molding production than hitherto had been found possible. The moral is obvious. With parallel conditions of material and labor costs, the foundry which will survive is the one which can make two castings grow where but one was found before.

## Real Hands Across the Sea

ONE of the most powerful factors underlying the remarkable growth and progress of the foundry industry in the United States during the past thirty years is found in the wholesale interchange of technical and trade information fostered by the American Foundrymen's association and other engineering societies, with the continuous co-operation of the business press. This fact is now appreciated by foundrymen in every section of the country. Robinson in Reading, Pa., is able to save time and money in solving his particular problems because he knows how Williams in Detroit has tackled similar difficulties. In an even more direct way, if that were possible, this constant interchange of information has assisted the work of scientific investigators and research organizations, with the result that the whole American castings industry has gone ahead with leaps and bounds far beyond what could have been accomplished in the secretive atmosphere fostered by an earlier generation.

But knowledge recognizes no national boundaries, and no one people have a monopoly on useful information. Therefore to achieve their highest aims foundrymen must be internationally informed. Hence the inauguration of a definite system of interchanging papers between the American and British foundrymen's associations, as described on another page in this issue, marks a new era of great promise to the castings industry of the world. The foundrymen of both the United States and the United Kingdom should receive great practical benefits from this exchange, especially if it is continued and broadened in scope. These benefits need not be confined to the business sphere. International concord, peace itself, rests on understanding, and in agreeing to exchange papers on technical subjects the foundrymen of Great Britain and America are contributing directly to a better understanding between their two countries and to a clearer appreciation of each other's methods, characteristics, problems and difficulties.

# Trade Outlook in the Foundry Industry

FREIGHT rates continue to form an obstruction to business against which is directed the condemnation of all industry. Reductions have been made in tariffs on agricultural products and the effect has been marked. A proposed decrease in the rates on sand, gravel and stone in Delaware, Pennsylvania, New Jersey and parts of Virginia and West Virginia is expected soon. Castings manufacturers feel the effect of the restrictive rates indirectly, but none the less severely. The purchasing agents association of Pittsburgh, through its president who is affiliated with a foundry has registered an appeal for reduction in freight rates as an aid to bettering industrial conditions.

**Situation Strengthens**

Continued evidences are at hand that the upturn is continuing. The automobile industry continues to be a factor and while there has been no notable change, castings orders continue to come from this source. Shipments of passenger cars for August showed an improvement over July and registered a total of 72 per cent of the August, 1920 record. Railway car orders are increasing slowly and repairs continue to furnish a fair volume of business for car castings foundries. Inquiry for railway cars during the month of September involved 5790 cars. Orders were placed for 2560 cars and about 50 locomotives, while track work and maintenance castings showed an increase over the previous month. A substantial improvement in the total melt of foundries is noted, particularly general jobbing shops, stove works and pipe plants. Machine tool and heavy gray-iron foundries are not so active as those handling light and medium work.

**Prices of Raw Material for Foundry Use**

CORRECTED TO OCT. 6

| Iron | | Scrap | |
|---|---|---|---|
| No. 2 Foundry, Valley | $21.00 | Heavy melting steel, Valley | $14.00 to 14.50 |
| No. 2 Southern, Birmingham | 19.00 | Heavy melting steel, Pitts | 14.00 to 15.00 |
| No. 2 Foundry, Chicago | 22.00 | Heavy melting steel, Chicago | 12.00 to 12.50 |
| No. 2 Foundry, Philadelphia | 21.35 to 22.25 | Stove plate, Chicago | 14.00 to 14.50 |
| No. 2 Foundry, Buffalo | 19.50 to 21.00 | No. 1 cast, Chicago | 14.50 to 15.00 |
| Basic, Valley | 19.00 to 20.00 | No. 1 cast, Philadelphia | 17.00 to 18.00 |
| Basic, Buffalo | 19.00 to 20.00 | No. 1 cast, Birmingham | 17.00 to 17.50 |
| Malleable, Chicago | 22.00 | No. 1 cast, Buffalo | 12.00 to 12.50 |
| Malleable, Buffalo | 20.00 to 21.00 | Car wheels, iron, Pittsburgh | 18.00 to 18.50 |
| **Coke** | | Car wheels, iron, Chicago | 16.00 to 16.50 |
| Connellsville foundry coke | $4.50 to 4.75 | Railroad malleable, Chicago | 15.00 to 15.50 |
| Wise county foundry coke | 5.75 to 6.50 | Agricultural mal., Chicago | 15.00 to 15.50 |
| | | Railroad malleable, Buffalo | 14.00 to 14.50 |

**Seasonal Demand**

The gain in stove foundry operation and the increase in activity among the radiator and furnace plants in some measure is due to the approach of winter, which has driven many purchasers into the market and has created a demand from throughout the country. Buying in these lines up to this time has been from hand to mouth and only small stocks were carried by the manufacturers, so that the reaction all down the line to the foundries is rapid. Manufacturers state that despite reports of large stocks of heating units, prevalent during the summer, many have carried less than 25 per cent of the normal supply of assembled heating units or of stock castings. The result has been a prevalence of hurry-up orders which have multiplied. This movement has been assisted in a large measure by a steady pick-up in building construction. Pipe foundries also continue to be actively engaged. Needed extensions, held in abeyance during the war, are being pushed by municipalities as an aid in the unemployment crisis. Private demand, too, continues in fair volume. Operations in cast iron pipe plants are substantially above other branches of the industry, ranging in some instances to 70 or 80 per cent of capacity. Orders continue to maintain a back-log capable of sustaining the present scale of operations for about 60 days. Normally spring demand is noted by the first of the year, so that pipe foundries anticipate continued prosperity.

**Iron Sales Increase**

Manufacturers of sanitary ware, radiators and plumbing supplies share with the cast iron pipe foundries in increasing purchases of pig iron. Prices of iron and coke are strengthening as the foundry melt increases. Blast furnace activity, as indicated by statistics compiled by *The Iron Trade Review*, is gaining steadily. September showed an improvement over August, both in total production and daily rate. The total amount of pig iron produced during September was 975,912 tons as compared with 954,901 tons for the previous month. Further, the number of stacks in blast increased by 15, bringing the total in operation to 84. The output of merchant iron for September was 157,391 tons, which compared with the August output of 134,491 tons gives a gain of 22,900 tons. The average daily production of this grade of pig iron was 5246 tons, an increase of 908 tons or 21 per cent over the August daily average of 4338 tons. Pig iron salesmen report that many foundries have only small yard stocks. Of these, the shops which are resuming operations are specifying on contract or buying in advance through the remainder of the year. That stocks of all materials have been allowed to reach an exceedingly low point is evident. A case in point is a valley sheet steel mill which during the war maintained a large supply of rolls. Within the past few weeks this mill ordered a number of rolls from a roll foundry and the statement was made that these were the first purchased in more than a year.

**Nonferrous Prices**

Nonferrous prices, based on New York quotations in the *Daily Metal Trade* of Oct. 6, follow: Casting copper, 12.50c to 12.62½c; electrolytic copper, 12.75c to 12.87½c; lead, 4.70c; Straits tin, 27.00c to 27.12½c; aluminum, No. 12 alloy, producers' price, 23.80c to 24.00c and open market, 14.00c to 16.00c. Zinc is 4.60c, E. St. Louis.

# Equipment Inquiry Proves Elusive

## Volume of Demand Is Growing, but Fails to Keep Pace with Inquiries—Replacement and Repair Orders Furnish Basis for Belief in Early Improvement

INTEREST in foundry equipment, as evidenced by inquiries from castings shops, is much more active than at any time during the summer. However, many manufacturers and salesmen find that this interest is purely academic and is backed by no intention of ordering at this time. The volume of repair orders, particularly on molding machines and handling equipment indicates growing activity and is generally accepted as evidence of trade improvement that may bring orders for new machinery. New projects are few, but replacements and extensions of foundry equipment to secure more economical operation are supplying a light demand. The Rogers Foundry Co., Detroit has been incorporated to produce iron and steel castings. C. O. Rogers., Monroe, Mich., and Alex Hungles, 448 Yale street, Detroit are incorporators. The Roxbury Steel Castings Co. has purchased the holdings of the Union Steel Castings Co., Boston and will expand the foundry to handle larger castings.

*Fruitless Inquiry Governs in the East*

ALTHOUGH practically all sellers of foundry equipment in the East report no improvement in buying, some assert there is a better volume of inquiry. However certain foundries appear to be shopping around, and even those which are figuring more seriously do not seem to show any inclination to close immediately. Aside from the improvement in operations at the pipe and stove foundries, there is little increase in production schedules, with the result that most foundries do not feel like going ahead with their purchases. No doubt sentiment is better, but thus far there has been little actual business. It has been the delay in developments of a definitely encouraging character that has stood in the way of several new projects being undertaken. Estimates on equipment have been taken in some instances, but nothing further has developed. On the other hand, some projects seem to be getting definitely under way. One is a small foundry for the Joseph Toye Co., Bridgeport, N. J., for which some orders have been placed recently. Another is the 100-ton foundry of the Hudson City Steel Co., Hudson, N. Y., for which the general contract has been awarded. The Hudson river vehicular tunnel project at New York City is expected to develop within the next 30 days. It is probable that several foundries will be awarded a portion of the work for this project, and that substantial orders for equipment will have to be placed by foundries participating.

*Demand Spotted in Pittsburgh District*

CERTAIN lines of foundry equipment are in more popular demand in the Pittsburgh district than others. While flasks and ladles are asked for in good numbers, core ovens, sand mixers, sand cutters and some heavier equipment are not receiving much attention. Recent ladle sales included a 1000-pound and 1500-pound ladles to one user. Three or four others have been ordered during the past week and all are for immediate delivery. Sellers of flasks report numerous inquiries, but few become orders. Some propositions are held up because of lack of appropriations, while others practically have been abandoned. A case in point is a foundry in Parkview, near Pittsburgh, for which the foundations, steel frame, roof and cupola were completed last May, since which time no further steps have been taken in connection with its construction. Consequently orders for additional equipment from this source are held up indefinitely. Sellers of small supplies witness a steady growth each succeeding month, September showing an increase over August, and October promising a like gain over September. Molding machine inquiries are lacking from Pittsburgh and vicinity, but are increasing from week to week from more distant points. Manufacturers state that a decided improvement has been brought about in the past 30 days; inquiries are more numerous and orders are in proportion. The Herman Pneumatic Machine Co. reports increasing inquiries. A heating equipment manufacturer of the middlewest which is a large user of molding machine equipment now is figuring on more installations. The Chapman Valve Co., Indian Orchard, Mass., and the Rensselaer Valve Co., Troy, N. Y., recently purchased a rollover machine and a jar stripping plate machine. While Pittsburgh district foundries are increasing their pig iron melts, to date they only have been able to utilize a portion of their present equipment which makes it needless for them to add new. Refractory manufacturers note an increased demand for cupola linings and the demand for brick from foundries has been fairly heavy. A prospective purchaser of foundry equipment is J. F. Richards who is about to erect a $100,000 foundry at Nanticoke, Pa.

*Fair Demand Noted by Chicago Makers*

THAT foundries tend to increase their operation is shown by an increase in demand for repair parts. The National Engineering Co. has shipped a Simpson mixer to be used in that section of the south showing the effect of the improved cotton market. The Whiting Corp. has sold a No. 9 cupola to the Niagara Radiator & Boiler Co., North Tonawanda, N. Y. This builder has several cupolas under construction in its shop, but finds a compartively small percentage of inquiries can be converted into orders. Two reductions of 10 per cent each have been made in cupolas during the past two months, following the downward movement of steel plates. One product this maker finds active is a helical gear which can be installed on any ladle and which is moving readily. A number have been sold recently for the Dodge and Ford foundries and also have been installed at the plant of the James A. Brady Co., Chicago. Henry E. Pridmore recently has sold a large electric jolt molding machine to the H. B. Smith Co., Westfield, Mass., following the sale of several stripping plate machines to the same interest. The Pridmore shop also has taken orders for several stripping plate machines and a rockover machine for eastern users. This manufacturer sees some prospective business from Ohio. Electric furnace builders for the most part find business exceedingly dull and inquiry among them reveals that most foundries do not have sufficient use at present for the furnaces they now have. Foundry supplies are moving fairly well, but users are not taking more than they require for immediate use. The General Iron Works Co., Denver, Colo., is planning a foundry estimated to cost $500,000.

# Comings and Goings of Foundrymen

FRANK P. GILLIGAN, whose election as president of the American Society, for Steel Treating was announced at the convention in Indianapolis Sept. 19-24, was the first chairman of the Hartford, Conn., section of that society. Mr. Gilligan is active in a number of other technical associations and is secretary of the Southern Engineering Co., Hartford. Other officers elected for the current year are vice president, F. C. Lau, Arrow Forging & Tool Works, Chicago and R. J. Allen, Rolls-Royce Co. of America, Springfield, Mass; and treasurer, J. V. Emmons, Cleveland Twist Drill Co., Cleveland. W. H. Eisenman 4600 Prospect avenue, Cleveland is permanent secretary of the Society.

L. R. Lemoine, president of the United States Cast Iron Pipe & Foundry Co., sailed for Europe early in October.

David McLain, head of McLain's system, Inc., Milwaukee sailed for Europe Oct. 15, to make an extended trip through Great Britain and the continental countries which have large casting industries.

George H. Lambkin, who has been associated with the Sterling Wheelbarrow Co., Milwaukee, manufacturer of equipment for contractors and foundries for the past twelve years, has been appointed manager of the New York territory, with an office at 141 Center street, New York.

John T. Krieger, who has been carrying on special work for the Marion Machine Foundry & Supply Co., Marion, Ind., has returned to Knoxville, Tenn., where he is general superintendent for the W. J. Savage Co., manufacturer of coal mining, marble, mill and flour mill equipment. Mr. Krieger, who has been connected with the foundry industry for the past 15 years, at one time was with the Whiting & Calumet Foundry Equipment Co.

M. J. Cavalier, professor of metallurgy at the University of Toulouse, has arrived at Columbia university, New York, to take up his work as French exchange professor. He comes to America as a result of arrangements for an annual exchange of professors of engineering and applied science between French and American universities. Professor Cavalier, who is a widely known authority on metallurgical chemistry, will divide his time during the academic year among the cooperating institutions, Columbia, Yale, Cornell, Johns Hopkins, Massachusetts Institute of Technology and the University of Pennsylvania.

H. P. Parrock has resigned his petition as general manager of the Buffalo and Youngstown, O., plants of the Lumen Bearing Co. to engage in private practice in Buffalo while remaining on the directorate of the Youngstown organization. Mr. Parrock is a consultant on foundry subjects, specializing on design, construction and operation. He has been connected with the Lumen Bearing Co., since 1910, having previ-

FRANK P. GILLIGAN

ously been superintendent of the steel foundry of the Youngstown Foundry & Machine Co. and prior to that time assistant superintendent of the rolling department of the Pennsylvania Steel Co., Steelton, Pa., now a part of the Bethlehem Steel Co.

## Safety Sessions Consider Foundry Problems

With 2200 registered at the historic Massachusetts State House, Boston, the tenth annual congress of the National Safety council held from Sept. 26 to 30 demonstrated conclusively that safety work occupies a prominent place in all industry throughout the country. In the "A. B. C." session held Tuesday afternoon, the fundamental elements in connection with all safety work were brought out repeatedly in several papers. J F. Tinsley, general manager, Crompton & Knowles Loom Works, Worcester, Mass., detailed the essentials of a plant safety organization.

The metals section under the chairmanship of J. A. Oartel, chief of safety bureau, Carnegie Steel Co., Pittsburgh, held two important sessions. The first was devoted largely to foundry work and the second to rolling mills, by-product plants and general features. A. B. Root Jr., mechanical engineer of the Hunt-Spiller Manufacturing Corp., Boston, presented a paper on "Safe Practices in Pouring in a Foundry," in which he outlined the safety work in several foundries in New England. It has been difficult, he said, to get the proper co-operation of superintendents and foremen. The tendency some years ago was for these men to consider the use of safety appliances as a sign of weakness or effeminacy on the part of the worker. Like other speakers, Mr. Root emphasized the necessity of getting the complete co-operation of foreman.

In the discussion following Mr. Root's paper, J. R. Mulligan of the Pethlehem Steel Co., Bethlehem, Pa., inquired about cable slings in place of chains. C. H. Lethbridge of the American Mutual Liability Insurance Co., Boston, gave it as his opinion that cables because of the burning out of the lubricant would be unsatisfactory for use in hot places. However, T. H. McKenney, of the south works of the Illinois Steel Co. said that the use of cables in tranporting hot steel was common practice at his plant and he recalled no cases where accidents had resulted from the use of cables.

R. E. Shore, district manager of B. F. Sturtevant Co., Boston, presented a paper entitled "Elimination of Steam During Pouring" which was a comprehensive description of the proper heating and ventilating systems for foundries under varying conditions. A paper on "Electrical Hazards in Foundries and Steel Mills" was written by Walter Greenwood, safety engineer. Carnegie Steel Co., Youngstown, O., but due to the author's absence was read by C. H. Lethbridge of the American Mutual Liability Insurance Co., Boston. This paper took up the usual electric systems in foundries and in steel mills, which, it was pointed out, are much alike, and described the weak points from a safety standpoint.

## Will Disseminate Data on Research Results

At a recent meeting of representative Michigan manufacturers with the directors of the engineers research department of the University of Michigan, Ann Arbor, Mich., approximately $25,000 was pledged for use in making known the work of that department. About 50 manufacturers attended the meeting. Since the department was organized nearly a year ago, the laboratories under the direction of Prof. A. E. White, have been cooperating with the industries of the state in the study of problems the solution of which would result in public benefit. Considerable work has been accomplished already but at the recent meeting it was felt that through the lack of advertising funds the results were not available and wide publication of valuable data was prevented.

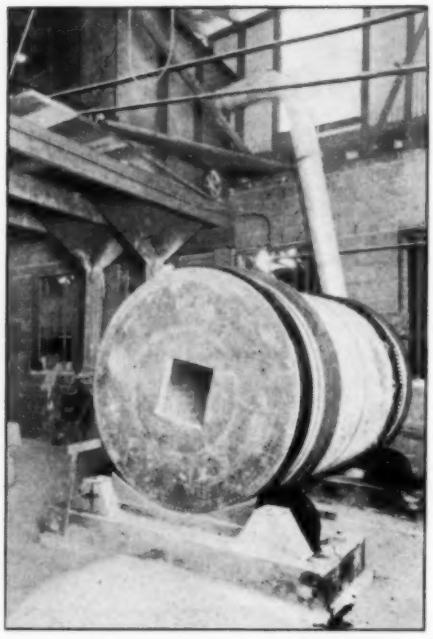
## Dust Arrester Doubles Capacity of Mill

In view of the steadily increasing use of enamel on cast iron it is interesting to note the experience of the Washington Iron Works, Los Angeles, Cal., in the preparation of the material. The accompanying illustration shows a 6 x 8-foot pebble mill connected to a dust arrester made by the W. W. Sly Manufacturing Co., Cleveland. The dust arrester is used for exhausting the product from the mill and the exhaust fan is driven by a variable speed motor.

At a fan speed of 850 revolutions per minute it is claimed that 1000 pounds of feldspar of 200 mesh and finer is collected in the dust arrester per hour. Feeding the mill continuously and running the fan at a speed of 1500 revolutions per minute, it is said, will result in the recovery of a ton of feldspar of 60 mesh and finer every hour. Other claims made since the installation of the dust arrester and exhaust fan are to the effect that the capacity of the pebble mill has been doubled, it is a dustless grinding unit, effects a recovery of 100 per cent of the material and insures a uniform product.

## Charging Machine Built To Conserve Lining

A new machine for charging foundry cupolas recently has been developed by the Motor Castings Co., Milwaukee. The machine, as shown in the



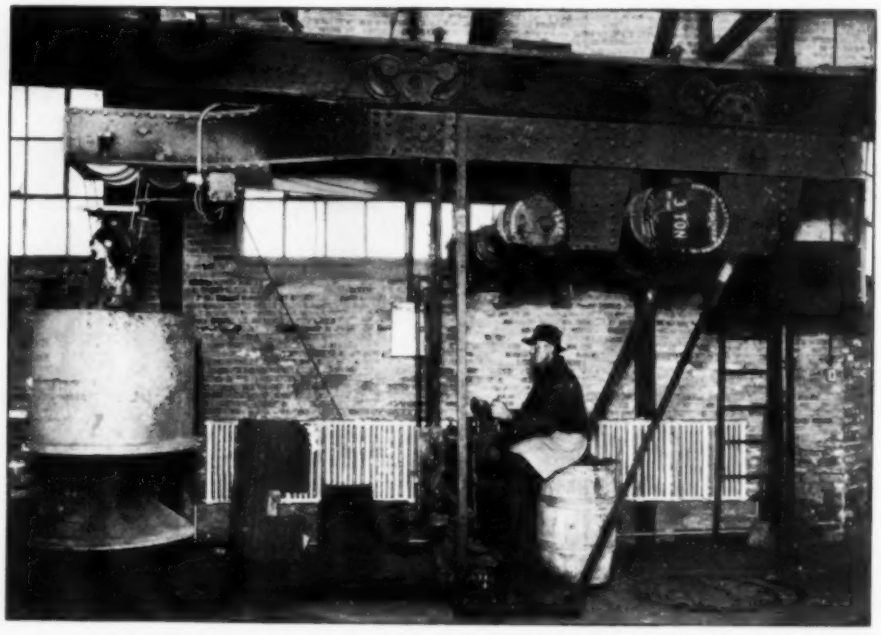
THE MILL IS FED CONTINUOUSLY THROUGH THE END OPENING

illustration, consists of a channel frame hung beneath an eye-beam runway and carrying a cylindrical bucket with a conical bottom which may be raised or lowered. The equipment is operated by one man, who, in addition to controlling the movement of the crane, operates two motors actuating the bucket. These are worked separately or in unison as desired. One motor controls the lowering of the conical bottom, while the other holds the cylindrical outer shell when the load is being discharged. The bucket is large enough to hold one complete charge of pig iron and scrap. The pig iron is placed in the bucket first and the scrap on top, so that when released, the pig iron will be placed on the coke first, which is a desirable condition.

A convenient arrangement for charging a cupola with this machine makes use of a run-way extending out into the yard where the pig iron and scrap is piled, and also in over the center of the cupola, with a stop to insure that the bucket is properly centered before the load is discharged. The operator receives his load in the buckets from the ground or from storage bins, raises it to the proper height, carries it in over the cupola, and then lowers the bucket to within three or four feet of the coke bed before the charge is released. This does not break the coke as much as if the charge were dropped from the cupola down. By this method of charging, the life of the cupola lining is said to be lengthened, because the iron is not thrown against the brick.

## Obituary

Henry J. Kinman, manager of the Cleveland plant of the Chicago Pneumatic Tool Co. since 1902, died recently at his home in Cleveland He was associated with Edward N. Hurley in the manufacture of air drills and together they formed the Standard Pneumatic Tool Co. in 1898 which in 1901 was consolidated in the Chicago Pneumatic Tool Co. Mr. Kinman was born in Harlem, Holland, in 1863 and came to America with his parents in 1870, settling in Chicago. He served his time with the Adams-Westlake Co., and other Chicago



ONE MAN OPERATES CUPOLA CHARGING MACHINE

manufacturers. He opened a machine shop in the basement of his home, working there nights. Later with his brother, T. P. Kinman, Mr. Kinman built the first practical portable piston air drill. It was soon after this he became associated with Mr. Hurley.

Alexander Fleck, president of Alex ander Fleck Ltd., Vulcan Iron Works, died at Ottawa, Ont. on Sept. 22, aged 54 years. Early in his career he worked a foundry and machine business in connection with his father and afterwards in partnership with Thomas Stewart bought out the business of which he subsequently became sole proprietor until the present company was formed.

James Edwin Frost, Smith's Falls, Ont., died in that city Sept. 22. Mr. Frost was a director of the Frost & Wood Co., and of the Smith's Falls Malleable Castings, Ltd., and was also secretary of the latter company.

# What the Foundries Are Doing

## Activities of the Iron, Steel and Brass Shops

Erection of a foundry is under consideration by the Rich Steel Products Co., Los Angeles.

The foundry and warehouse of the Reedy Foundry Co., Chicago, recently were purchased by the Oil & Chemical Corp.

Plans are being prepared by the J. Ryan Foundry Co., 506 Forty-first street, Rock Island, Ill., for the erection of a plant building.

Erection of a machine shop and foundry, 2-stories, 100 x 108 feet, is reported under consideration by J. P. Heath & Co., Waukegan, Ill.

The plant of the Pluff Mfg. Co., Boston, manufacturer of brass castings, recently was damaged by fire.

The plant of the Klamath Foundry & Steel Works, Klamath Falls, Oreg., recently was damaged by fire. It requests catalogs, etc.

The plant of the Bowie Stove Foundry, Rome, Ga., recently was damaged by fire. The loss was estimated at $100,000.

After being idle for several months, operations recently were resumed at the foundry of the East Ohio Mfg. Co., Youngstown, O.

The Pittsburgh Engineering, Foundry & Construction Co., Pittsburgh, is being organized by N. J. Wallace, F. C. McCutcheon and J B. Orr, to manufacture castings, etc. J. B. Orr, Farmers' Bank building, represents the company.

The capital stock of the Dayton Aluminum & Mfg. Co., Dayton, O., recently was increased from $10,000 to $50,000.

Capitalized at $30,000, the Brooks Piston Ring Co., Cleveland, recently was incorporated by W. A. Brooks, Charles Brooks, and others.

To be devoted to the manufacture of heaters, the Western Stove Co., Oakland, Cal., is erecting a plant building. J. J. Vaughan is general manager of the company.

The Ulmer Machinery Co., Porterville, Cal., is reported planning the erection of a modern foundry building, and is said to be in the market for some equipment.

Organized to manufacture brass, bronze, and aluminum castings, the Superior Brass Foundry, 316 First street, San Francisco, recently was incorporated by C. T. Kraft, and others.

Plans are being prepared by the General Iron Works, 1720 California street, Denver, for the erection of a foundry building, which with equipment is estimated to cost about $200,000.

The E. P. Bailey Co., Nitro, Va., has had plans prepared for the erection of a foundry and machine shop, which with equipment, it is estimated will cost about $100,000.

Fire recently broke out at the plant of the Valley Mold & Iron Corp., Pittsburgh, but was confined to the pattern shop. Damage was estimated at $10,000.

The Ohio Steel Castings Co., Cleveland, recently was incorporated with a capital stock of $1000, by John A. Elden, Harry E. Gresham, and others.

The Potts Stove & Burner Co., 2826 South San Pedro street, Los Angeles, recently was organized to engage in the manufacture of stoves, etc., by H. S. and T. E. Potts, and others.

Articles of incorporation recently were filed by the Shilling Foundry Co., Columbus, O. The organization is capitalized at $10,000 and incorporators are Fred Shilling, Edna Shilling, Clarence Shilling, and others.

Among recent incorporations is that of the General Casting & Machine Co., Jersey City, N. J., which was recently chartered with a capital stock of $125,000, to manufacture steel and other metal castings.

The Reid-Avery Co., 1434 Brandywine street, Philadelphia, operating an electric welding and repair works, has leased a 2-story building at Twenty-first street and Washington avenue, Philadelphia, for a new plant.

Erection of its factory has been completed by the Ampco Metal Products Co., Springfield Ill., and it has started the manufacture of brass and aluminum castings. B. F. Hayden is president of the company.

The American Brass & Aluminum Founders Co., 6833 South Irving avenue, Chicago, recently was incorporated to manufacture and deal in castings, novelties, etc., by Robert C. Fingel, Harry Banding, Anton A. Sikora, and others. The company is capitalized at $35,000.

Operations at the plant of the Ashland Iron & Mining Co., Ashland, Ky., now are at the rate of 50 per cent of capacity. It is understood that enough orders have been received to keep its furnaces and foundry running all through October.

A plant has been established on Houghton avenue, Trenton, N. J., by the Trenton Chilled Die & Casting Co., which was recently organized to engage in the manufacture of dies, castings, etc. John H. Conover is president of the company and R. B. Newton, treasurer.

The Terre Haute Malleable Mfg. Co., Terre Haute, Ind., is now operating at about 80 per cent of capacity. Employes have been gradually reinstated to their old position each week for the past three months and during that time operations have been steadily increased.

Operations have been resumed at the plant of the Western Foundry, Holland, Mich., large manufacturer of gray iron castings. It is reported the company is considering the erection of several plant additions in the near future, but this is unverified.

At a recent stockholders meeting of the Gale Mfg. Co., Albion, Mich., the following were elected officers: President, M. T. Conklin; vice president and treasurer, L. E. White; secretary, H. L. Stanton, and assistant secretary and factory manager, W. C. Sackett.

Reopening of the Cravens yard plant of the United States Cast Iron Pipe & Foundry Co., Chattanooga, Tenn., is scheduled for the next few days. It is expected the plant will be operated at about one-third of capacity and employ about 150 men.

E. G. Michaels, E. P. McIntire, J. J. Devitt and C. S. Lorentzen, 68 Broad street, New York, were named as the incorporators of the Mohican Brass & Copper Works, New York, which was recently chartered under New York state laws with a capital stock of $10,000.

R. J. Teetor, Muskegon, Mich., has plans under way for the erection of a foundry at Cadillac, Mich., which will be devoted to the manufacture of iron and steel castings. Frank D. Chase, Inc, Chicago, is engineer in charge of the project.

Plans have been completed by the Tomahawk Steel & Iron Works, Tomahawk, Wis., for the erection of a new foundry and machine shop, to replace its old plant which was destroyed by fire some time ago. The new plant will occupy a site on the main line of the Chicago, Milwaukee & St. Paul railway.

Operations have been resumed at the No. 2 plant of the Holmes Foundry Co., Port Huron, Mich., and it is understood plans are now being prepared for reopening of the company's No. 4 plant within the next 30 days. No. 3 plant of the company has been in continuous operation. The company manufactures automobile castings, etc.

Capitalized at $35,000, the Rogers Foundry Co., Detroit, recently was incorporated and plans to engage in the manufacture of iron and steel castings. In addition to operating a foundry the company will operate a machine shop. Incorporators of the company are C. O. Rogers, Monroe, Mich., Alex Hungles, 448 Yale street, Detroit, and William Reinhold, also of Detroit.

The Adria Motor Car Corp., Batavia, N. Y., recently increased its capital stock from $1,000,000 to $5,000,000. The company recently took over the plant of the Gray Machine & Parts Corp., which it will utilize for the manufacture of motor cars. The company is planning to utilize one of its structures for a foundry and remodeling will be undertaken within the next six months.

The Arcade Malleable Iron Co. recently purchased the plant of the Richard French Iron Works, at Worcester, Mass. The latter organization recently let a contract for the erection of a plant at Millbury, Mass., which is expected to be ready about Nov. 1. The new plant will

consist of two buildings, one to be 1-story, 65 x 120 feet, and the other, 1-story, 25 x 25 feet. The company recently increased its capital stock from $30,000 to $70,000.

Purchase of the property of the Union Steel Castings Co., 53 Gerard Roxbury, Boston, by the Roxbury Steel Castings Co., which was recently organized with a capital stock of $50,000, has been effected. Operations by the new company are to be started immediately, it is understood. The open-hearth furnace has been rebuilt to 15 tons capacity and the scope of the work extended to permit of castings up to 12 tons. Isaac E. Sexton has been elected president of the company and Perley C. Rogers treasurer and general manager. These two, with George A. Sexton, constitute the board of directors. J. T. Phelps has been retained as superintendent and R. L. Adams continues as head of the laboratory. The original foundry organization remains intact.

Specializing in the manufacture of light gray iron castings and semisteel castings, the Waukegan Foundry Co., Waukegan, Ill., has started operations. It was recently incorporated with a capital stock of $60,000, with main office and foundry at Waukegan, and a branch office at 549 West Jackson boulevard, Chicago. A new modern foundry building was erected by the Manufacturers Terminal Co. and this has been leased for a long period of years. It has been equipped with a cupola and other equipment includes molding machines, molders benches, sand blast equipment, tumbling barrels, etc., all of the most modern design. Officers of the company are: President, Andrew K. Barr; vice president, Elmer L. Clavey, and secretary and treasurer, Elmer T. Skidmore.

# New Trade Publications

FIRE BRICK.—The Ashland Fire Brick Co., Ashland, Ky., has published an 8-page illustrated bulletin entitled, "Fire Brick for Rotary Cement Kilns." The booklet contains a short resume of conditions, describes the various types of fire brick under certain conditions and other data of interest.

PNEUMATIC TOOLS—The George Oldham & Son Co., Baltimore, is circulating five booklets under one cover, in each of which a different kind of pneumatic tool is described. The tools described include scaling tools, sand rammers, riveting hammers, jam riveters and chipping hammers. Each is described and illustrated in detail as well as the various accessories, etc.

HOT-BLAST HEATER—Robert Gordon, Inc., Chicago, is circulating a 40-page illustrated booklet in which hot-blast heating equipment is described and illustrated. In addition to a detailed description of the equipment, which is augmented with illustrations of actual installations, etc., the booklet is replete with testimonial letters, etc.

WELDING AND CUTTING—The Davis-Bournonville Co., Jersey City, N. J., has published a 96-page illustrated booklet containing instructions for the care and use of oxy-acetylene apparatus and equipment. The booklet, primarily is intended for experienced operators who have mature judgment and some knowledge of metal-working practice.

FURNACE DESIGN—The W. S. Rockwell Co., New York, is circulating a 20-page booklet containing a series of three papers illustrating the variety of design of furnaces to meet modern industrial heating requirements. The papers are entitled, "The Variety of Industrial Heating Requirements", "Regenerative Furnaces", and "The Relation of Type and Arrangement of Furnaces to Cost of Production."

TEMPERATURE INDICATOR.—The General Electric Co., Schenectady, N. Y., is circulating an 8-page illustrated bulletin in which a temperature indicator for transformer windings is described and illustrated. This instrument, according to the bulletin, affords the operator a convenient means of determining at the switchboard the hot-spot temperature of the windings of transformers under all operating conditions. The bulletin contains a complete wiring diagram, as well as the principle of operation, safety and accuracy of the new device.

MOTORS—The Allis-Chalmers Mfg. Co., Milwaukee, has published a 12-page illustrated booklet in which polyphase induction motors continuous rated, are described and illustrated. A prominent feature of these motors is the use of cast steel wherever practical and other features of design and construction include an efficient system of ventilation, whereby cooling of the internal parts is secured. Bearings are of liberal design with oil wells of large capacity; rotar bar end fastening of squirrel cage construction; conduit terminal boxes furnished with all motors.

HOIST.—The Sullivan Machinery Co., Chicago, has published a 4-page illustrated leaflet in which a small air hoist is described and illustrated. According to the leaflet, this hoist may be mounted on a cross bar or column in a shaft, winze or raise, for handling drills, steel or timber; it may be bolted to a timber or girder or to a wall or floor for pulling cars, piling lumber and various odd jobs of hauling and hoisting. It has a capacity of 1500 pounds dead load lifted vertically at 100 feet per minute under 80 pounds air pressure. Other details are given.

CABLEWAY—The Railway & Industrial Engineering Co., Greensburg, Pa., has published a 4-page illustrated colored folder, in which a rocking cableway for material handling, is described and illustrated. The cableway is said to embody crane service with cableway speed. It is claimed to be particularly applicable to blast furnace yards, coal storage, crushed rock storage, and in fact wherever materials are stored in selective piles, or moved from cars, pockets, mills or yards. The system is a cableway in which the supporting towers rock in unison through 120 degrees by means of cables controlled by the operator. Full details are given.

FURNACE CHAIN SCREEN—Chain furnace screens are described and illustrated in an 8-page illustrated booklet recently published by E. J. Codd Co., Baltimore. These screens are said to have been widely applied on metallurgical, glass and chemical furnaces in all sections of the world. The screens consist of a multitude of individual strands of steel chain, forming a penetrable transparent sheet of chain, which does not interfere with the view of the interior of the furnace, nor the passage of a charge. At the same time, it is claimed that through the use of the screens a minimum amount of heat is lost.

HEATING—A 32-page illustrated booklet has been published by Robert Gordon, Inc., Chicago, in which main points to be considered by plant owners in considering heating, ventilating and air conditioning apparatus are set forth. The booklet is chiefly devoted to heating systems and goes into minute detail as to installation, etc. This heating equipment consists of a cast iron heating element enclosed in a large sheet metal casing provided with air outlets. The air is drawn from the building and passed over the radiating surface of the equipment by a fan, which is operated either electrically or by line shaft, gasoline motor or other motive power. Other details are given, in addition to the description of a small type of heater, while a list of installations are given, and small descriptions of process piping, pneumatic conveying, etc., given.

METAL SPRAYING—The Metals Coating Co. of America, Philadelphia, has published an 18-page illustrated booklet in which a process of metal spraying is described and illustrated. According to the booklet in this process the coating metal adheres to the object chiefly by mechanical union. The metal is discharged in hot impalpable particles moving with high velocity, and these when directed upon a prepared object penetrate the pores of the latter while the spray is still plastic. The coating metal thus dovetails itself into the superficial pores of the object, and according to the booklet, does so in the presence of reducing gas which prevents oxidization at the junction of the metals. The booklet gives complete details, as to its advantages in various kinds of work, and the data given not only are instructive, but extremely interesting.

PUMPS.—Dry vacuum pumps, single cylinder, steam and belt driven, are described and illustrated in a 12-page illustrated booklet recently published by the Sullivan Machinery Co., Chicago. These pumps are built in capacity ranging from 300 to 1600 cubic feet displacement per minute. According to the booklet these pumps are of the center crank pattern with main bearings, crank shaft and fly wheels at one end of the machine, and the vacuum, or the steam and vacuum cylinders at the rear end. The frame is of rugged construction. The crank shaft is supported in removable, die-cast babbitt bearings, which are carried by seats in the frame. Other parts of the machine are described and specifications are given.

ELECTRIC TRAMRAIL.—The Cleveland Electric Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O., has published a large looseleaf booklet in which an electric overhead trucking system, adaptable for use in practically every industry and industrial plant, is described and illustrated. The most dominant features of the equipment are pointed out in detail. Its versatility is emphasized, and according to the booklet, literally overcomes all obstacles in the conveyance of materials up to two tons in weight. It reaches into every corner of the plant, passes from room to room, from building to building, around posts, through doors, up inclines from floor to floor by the use of elevators, and even can be used to suspend window cleaners on modern skyscrapers. Various installations of the equipment are described and illustrated, including its use in foundries, warehouses, rubber plants, coal handling plants, garages, painting department, etc. The tramrail system, which complete weighs 4000 pounds or less, is a combination of standardized rail, fittings and carriers, which have been developed to meet the demand for an inexpensive system of shop transportation. All working parts are fully enclosed and it is impossible for the carrier to run off the rail. Steel cut gears and pinions are used throughout with the exception of one idler, which is cut from micarta. A direct-current motor of special design is used on all carriers. This latter is equipped with compensating windings, ball bearings on both ends, and the motor is sufficiently large to offer a liberal factor of safety. All wires on the carriers are closed in flexible steel conduit and all electrical connections soldered. All insulators are tested for 2300 volts. All parts are interchangeable. In addition full descriptions of the various parts and appliances are given and several pages of the booklet are devoted to describing and illustrating the company's cranes and transfer bridges.